Carleton University

1973-74
Calendar

Faculty of
Graduate Studies

CARLETON UNIVERSITY

Ottawa, Ontario

FACULTY OF GRADUATE STUDIES

1973-74

Calendar

As this Calendar is published several months before the opening of the session, the University reserves the right to make whatever changes circumstances may require, including cancellation of particular courses.

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Founded in 1942 as a non-denominational, private and coeducational college, Carleton initially occupied scattered rented quarters in downtown Ottawa. Since that time the University has expanded to keep pace with rising enrolment and the main campus is now located on a large and picturesque site between the Rideau River and the Rideau Canal.

The University offers programs of undergraduate study leading to bachelor's degrees in Arts, Journalism, Commerce, Science, Engineering, and Architecture, and to a certificate in Public Service Studies.

Programs of graduate study, first offered at Carleton in 1954, provide opportunities for advanced study, research, and critical scholarship in a number of disciplines. Carleton's libraries, laboratories, and other research

facilities enable graduate students to perform scholarly work of consistently high calibre, and help to foster a spirit of independent investigation.

The location of the University in Ottawa also enables graduate students to take advantage of the research and library facilities associated with many national institutions and government departments.

Graduate programs currently offered at Carleton are the following:

GRADUATE DIPLOMA IN PUBLIC ADMINISTRATION (D.P.A.)

MASTER OF ARTS (M.A.) in Canadian Studies, Classics, Comparative Literature, Economics, English, French, Geography, German, History, International Affairs, Philosophy, Political Science, Psychology, Public Administration, Spanish, Sociology, and Soviet and East European Studies.

MASTER OF ENGINEERING (M.Eng.) in Aeronautical, Civil, Electrical, Materials, and Mechanical Engineering.

MASTER OF SCIENCE (M.Sc.) in Biology, Chemistry, Geology, Mathematics and Physics.

MASTER OF SOCIAL WORK (M.S.W.) in Social Work.

DOCTOR OF PHILOSOPHY (Ph.D.) in Biology, Chemistry, Economics, Engineering (Aeronautical, Civil, Electrical, and Mechanical), Geology, History, Mathematics, Physics, Political Science, Psychology, and Sociology.

The full-time graduate enrolment in 1972-73 comprised a total of 633 students, including 19 in the D.P.A. program, 36 in the Qualifying Year program, 452 in the Master's program and 126 in the Ph.D. program. In addition, 486 students were registered for part-time graduate studies.

The graduate degrees and diplomas awarded by the University in 1972 included:

Doctor of Philosophy 19
Master of Arts 193
Master of Science 29
Master of Engineering 41
Master of Social Work 47
Diploma in Public Administration 34

The studies of each candidate will be directed by a department, institute, or school, and are governed by the general regulations outlined in this Graduate Studies Calendar.

Persons consulting the Calendar are advised to refer to both the General Regulations section and the Departmental Program Descriptions. Regulations common to all departments are outlined in the general section while the specific or additional requirements of each department, division, institute, or school are stated in the departmental program description sections.

The policies and regulations outlined in this Calendar have been approved by the University Senate and supersede all previous publications and documents governing graduate studies at Carleton University.

ACADEMIC SCHEDULE

The following schedule of dates has been prescribed by the University Senate for academic activities and procedures.

Spring Term and Summer Session 1973

May 16, 17 . . . . . Registration for spring term.

May 21 . . . . Statutory holiday, University closed.

May 22 . . . . Spring term classes begin.

May 29 . . . . Last day for late registration for spring term.
Last day for spring term course changes.
Last day for spring term re-registration in theses and research essays. (See, also, Thesis and Research Essay Re-registration in the Calendar.)

July 2 . . . . Statutory holiday, University closed.

July 3 . . . . Registration for summer session day division.
Last day for withdrawal from spring term courses without academic penalty and with partial refund of fees.

July 4 . . . . Summer session day classes begin.

July 10 . . . . Last day for late registration for summer session.
Last day for summer session course changes.

July 24 . . . . Last day for withdrawal from summer session courses without academic penalty and with partial refund of fees.

August 6 . . . . . . Civic holiday, University closed.

August 14 . . . . . Last day for spring term and summer session classes.

August 15-18 . . . . Spring term and summer session examinations.

Fall Term 1973

June 1 . . . . Last day for the receipt of applications for fall term registration from candidates whose documents originate outside Canada. Supporting documents (transcripts, letters of reference, etc.) must be received by the 30th of June. Applications from candidates in this category who intend to register initially for the winter term must be received by the 1st of October; and for the spring term by the 1st of February.

August 15 . . . . . Last day for receipt of application for fall term registration from candidates resident in Canada. Supporting documents (transcripts, letters of reference, etc.) must be received by the 1st of September. Applications from candidates resident in Canada who intend to register initially for the winter term must be received by the 1st of November; and for the spring term by the 1st of April.

September 3 . . . . . Statutory holiday, University closed.

September 4 . . . . . Last day for submission, to the thesis supervisor, of four examination copies of the Ph.D. thesis for Fall Convocation. See, also, October 22.

September 7 . . . . . Last day for receiving applications for degrees from potential graduates for Fall Convocation.

September 10, 11 . . Registration of part-time graduate students for the fall and winter terms.

September 12, 13 . . Registration of full-time graduate students for the fall and winter terms.

September 17 . . . . Classes begin in all courses.

October 1 . . . . . . Last day for submission, to the thesis supervisor, of four examination copies of the Master's thesis for Fall Convocation. See, also, October 22.

October 5 . . . . . . Last day for late registration for fall term.
Last day for course changes for full-courses and fall term half-courses.
Last day for fall term re-registration in theses and research essays. (See, also, Thesis and Research Essay Re-registration in the Calendar.)
Students who have not met that deadline, and who register in the fall term, are entitled to withdraw after four final copies of their theses are deposited in the Graduate Studies Office. The only exception concerns students who were not registered in the spring term; in that case, they must be registered for the entire fall term.

October 8 . . . . . . Statutory holiday, University closed.

October 22 . . . . . Last day for submission, to the Graduate Studies Office, of four final copies of Master's and Ph.D. theses for Fall Convocation.

October 26 . . . . . Last day for withdrawal from fall term half-courses without academic penalty and with partial refund of fees.

November 2 . . . . . Fall Convocation for the conferring of degrees.

December 14 . . . . Last day of fall term classes.

December 15-21 and   Mid-year examinations, including half-course finals,

January 2-5 . . . . . may be scheduled as announced.

December 25 . . . . Statutory holiday, University closed.

Winter Term 1974

January 1 . . . . . . Statutory holiday, University closed.

January 3, 4 . . . . . Registration for winter term.

January 7 . . . . . . Winter term classes begin.

January 25 . . . . . . Last day for course changes for winter term half-courses.
Last day for late registration for winter term.
Last day for winter term re-registration in theses and research essays. (See, also, Thesis and Research Essay Re-registration in the Calendar.)

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February 1 . . . . . . Last day for receiving applications for degrees from potential graduates for Spring Convocation.

February 15 . . . . . Last day for withdrawal from full-courses and winter term half-courses without academic penalty and with partial refund of fees.

February 25-March 2 Study period.

March 1 . . . . Last day for receipt of applications for admission from candidates who wish to be considered for the initial award (April 1) of financial assistance (including Carleton Fellowships, scholarships and departmental assistantships) administered by Carleton University. Supporting documents (transcripts, letters of reference, etc.) must be received by the 15th of March. Candidates whose applications are received after the March 1st deadline date may be eligible for the award of a fellowship, scholarship or assistantship by reversion. Awards by reversion are normally considered on or about the 15th of May, 15th of August, and 1st of October.

April 1 . . . . Last day for submission to the thesis supervisor, of four examination copies of the Ph.D. thesis for Spring Convocation. See, also, May 20.

April 11 . . . . Last day of winter term classes.

April 12-14 . . . . . Easter Weekend, University closed.

April 17-May 4 . . . Final examinations may be scheduled as announced.

April 29 . . . . Last day for submission to the thesis supervisor, of four examination copies of the Master's thesis for Spring Convocation. See, also, May 20.

May 20 . . . . Last day for submission, to the Graduate Studies Office, of four final copies of Master's and Ph.D. theses for Spring Convocation.

May 31 . . . . Spring Convocation for the conferring of degrees.

GENERAL REGULATIONS

ADMISSION REQUIREMENTS

Graduates of recognized universities, with at least second class standing will be considered for admission into the Faculty of Graduate Studies. The University's general policy on admissions is outlined below, but all applicants should refer to the departmental statements in this Calendar for details concerning the specific or additional requirements of each department, division, institute, or school.

Master's Program

An Honours bachelor's degree (or the equivalent) with at least second class standing is required for admission to the Master's program. The applicant must also be recommended by the department in which he plans to undertake his studies.

Applicants for a Master's degree who have a program requirement of seven full-courses or less will register directly in the Master's program.

Qualifying Year Program

Applicants who do not qualify for direct admission to the Master's program may be admitted to a Qualifying Year program. Applicants having undergraduate degrees which are comparable to a pass degree from Carleton University (rather than an Honours degree) will normally be admitted to a Qualifying Year program.

If successful in this Qualifying Year, they may proceed to the Master's program the following year. However, admission to the Qualifying Year program does not imply automatic admission to the Master's program. At the end of the Qualifying Year, the department will determine the student's eligibility to enter the Master's program, and the student will be informed of this decision by the Dean of the Faculty of Graduate Studies.

Applicants for a Master's degree who have a program requirement of eight full-courses or more will register initially in the Qualifying Year program.

Doctoral Program

A Master's degree, with at least high second class standing from a recognized university, is ordinarily required for admission into the Ph.D. program.

APPLICATION FOR ADMISSION

Applications for admission to the Faculty of Graduate Studies should be made on prescribed forms available from the major department or the Graduate Studies Office and submitted directly to the department.

Deadlines

Candidates whose documents originate outside Canada must apply by the 1st of June. All other applications must be received no later than the 15th of August.

Applicants wishing to be considered for the award of a fellowship, scholarship or assistantship administered by Carleton University are reminded that they must submit their applications for admission by the 1st of March and that the supporting documents (e.g. transcripts and letters of reference) must be received by the 15th of March.

Transcripts

Detailed official transcripts of the applicant's entire university record must be sent to the chairman of the department concerned.

Letters of Reference

All applications must be supported by letters of recommendation from at least two faculty members under whom the candidate has studied and who are in a position to assess his potential for graduate studies and research. These letters are to be sent by the referees directly to the chairman of the department.

Application to Graduate

Students are referred to the Academic Schedule which identifies the dates by which prospective graduates must make application for Spring and Fall graduation, respectively, in the Graduate Studies Office.

TRANSFER OF CREDIT

Graduate courses completed at another institution may be accepted in partial fulfilment of Carleton's degree requirements. Credit for such work will be determined by the Executive Committee of Graduate Studies on the recommendation of the department concerned.

Full-time Master's candidates are allowed a maximum of two transferred full-course credits; part-time students are permitted only one such course. If a Master's candidate is granted transfer credit for two full-courses, his remaining three courses at Carleton must be at the 500 level.

Doctoral candidates may be given up to one year's credit for work completed at other universities, but must register for a minimum of one year of full-time studies thereafter at Carleton, during which time the thesis and comprehensive examination will be undertaken. Students admitted with transfer of credits in a Ph.D. program may be required to pass a qualifying examination upon entry.

Course work completed as a Special Student is not normally acceptable for degree credit in the Faculty of Graduate Studies. In exceptional cases, transfer of credit may be permitted for a maximum of two such courses provided that the student has obtained high standing. The total number of transferable credits (i.e., credits from another university and/or credits earned as a Special Student at Carleton) is limited to two full courses or the equivalent.

If a student has been formally admitted, and has *not* lost his eligibility to register in the program, consideration will not be given for the transfer of credit of any courses in which the student is registered in a status different from his formal eligibility at admission.

Similarly, if a student, formally admitted to Carleton, wishes to enrol in courses at another university, credit will be granted only if written permission is received from the Dean of Graduate Studies that the courses may be taken for credit. Such permission must be received in advance of registration for the course work.

In all cases, however, work counted for credit must fall within the time limitation for graduate study (see TIME LIMIT), and any transfer credit must be established at the time of admission or initial registration.

PROFICIENCY IN ENGLISH

Proficiency in English usage is considered necessary to pursue graduate studies at Carleton. Departments may request that applicants whose native tongue is not English be tested for proficiency in the English language. In such cases, the applicant will be advised to write to

> English Language Institute
> Testing and Certification Division
> The University of Michigan
> North University Building
> Ann Arbor, Michigan 48104
> U.S.A.

and make arrangements for the language test at a charge of fifteen dollars. The Carleton Faculty of Graduate Studies will secure the results directly from the Testing Institute.

ADMISSION PROCEDURES

All applications for admission will be initially examined and evaluated by the department, division, institute, or school in which the applicant wishes to study. All supporting documents (transcripts, letters of reference, and the like) must be received before any application can receive formal consideration.

The applications of those students whom the department wishes to recommend for admission will be forwarded, when completed, to the Dean of the Faculty of Graduate Studies for consideration and approval. The office of the Dean will officially notify all applicants who are approved for admission.

The Statement of Standing on Admission issued to each newly admitted applicant is valid only for the twelve-month period stipulated on the form. If the applicant fails to register within this period of time, his admission and registration eligibility will lapse automatically. He may, of course, re-apply for admission in the regular way.

PROGRAM REQUIREMENTS

A description of each program offered under the auspices of the Faculty of Graduate Studies is presented in the DEPARTMENTAL PROGRAM DESCRIPTIONS AND DETAILS OF COURSES section of this

Calendar. Prospective applicants should note particularly the admission requirements, the fields in which advanced study and research may be undertaken and the program requirements of each department in addition to the following general regulations of the Faculty of Graduate Studies.

REGISTRATION

The Faculty of Graduate Studies divides the calendar year into three terms, and the Academic Year (September-May) into two terms. Each term comprises about 13 weeks of lectures or seminars. The first term of the Academic Year is designated as the *fall* term (registration period in mid-September). The second term of the Academic Year is designated as the *winter term* (registration period early in January). The third term of the calendar year is designated as the *spring term* (registration period late May). Some graduate and senior undergraduate courses are also offered in the *summer session* (registration period early in July) which comprises approximately six weeks of lectures or seminars. The precise dates of registration for the fall, winter and spring terms and for the summer session are specified in the Academic Schedule of this Calendar.

All students enroling at Carleton are required to register in their programs at designated times prior to the beginning of classes. Those who register later than the dates indicated in the Academic Schedule will be charged an additional fee.

All graduate students initiate their Registration procedures by proceeding directly to the department concerned. Information concerning all phases of Registration will be available from the departments during this initial step of Registration.

The onus to establish that a student is properly registered in a course rests with the student who should be governed by regulations in this Calendar.

Credit will be granted only for those courses and research activities for which the candidate is formally registered. An unregistered student is not entitled to attend lectures, tutorials, or seminars and is not entitled to thesis supervision, examination privileges, access to research facilities, and the like. A student will receive no credit for any work completed during a term in which he was not properly registered.

Status

A full-time graduate student will normally register in a minimum of three half-courses (or the equivalent) per term.

Part-time students are permitted to enrol in a maximum of two half-courses per term.

All students are reminded that status is established only by formal registration in the appropriate subjects or courses for each term of activity in the calendar year. See also CONTINUOUS REGISTRATION.

Definition of full-time study

In addition to the *course load* requirements described above, the following criteria for full-time status have been established by the Ontario Ministry of Colleges and Universities:

- *The student must identify himself as a full-time student.* That is, he must so register during each term of activity.

- *The student must be geographically available and visit the campus regularly; he may not be absent from campus without permission for a period exceeding four weeks in any term.* Students wishing to undertake full-time studies off-campus must secure, in advance, the written permission of the departmental chairman and the Dean of Graduate Studies (see OFF-CAMPUS RESEARCH).

- *A full-time graduate student may not be regularly employed on other work (or by the university) for more than an average of 10 hours per week during any period of full-time registration. If the student is employed as a teaching or research assistant or laboratory demonstrator, the 10 hours per week should represent the total time devoted to these duties; that is, it includes time spent on preparative work, marking, etc.*

Course Selection

A student proceeding to a graduate degree or diploma must arrange his program according to the regulations of the Faculty of Graduate Studies and the major department, and must have his selection of courses approved by the department during Registration.

The course and thesis requirements of each graduate program are organized or defined in units of full-course credits. A full-course credit typically comprises three hours of lectures or seminars per week for two terms, or the equivalent. A half-course credit typically comprises three hours of lectures or seminars per week for one term, or the equivalent.

Audit Courses

Graduate students may register to attend a course without receiving credit. Full-time students may register to audit one course without an additional fee; all others must pay the regular course fee.

Thesis and Research Essay Re-Registration

A student who does not complete the thesis requirement before the end of his period of registration and who elects to complete the thesis requirement *on a part-time basis* during a subsequent term, must re-register on prescribed forms. This re-registration is required for any term or period during which the student plans to be actively engaged in the completion of the

thesis requirement and must be *received* on or before the last date for course changes in each term, as specified in the Academic Schedule.

The per-term fee for re-registration is equivalent to the prevailing fee assessment for a half-course.

Re-registration is *required* in at least two out of every three consecutive terms (see CONTINUOUS REGISTRATION) and in the term during which the student expects to complete and/or be examined in the thesis (or research essay). Completion means modifications, any retyping involved, etc. of the four final copies of the thesis or research essay for deposition in the Graduate Studies Office.

Re-registration by mail is acceptable provided that the prescribed form is completed and returned together with fee payment (cheque or money order) on or before the deadline date.

The re-registration regulations apply to research essays as well as to theses. All such re-registration must be completed on or before the last day for late registration for the term involved.

QUALIFYING YEAR PROGRAM

Students in the Qualifying Year will ordinarily register in five full courses (or the equivalent) at the senior undergraduate level. Of these five, no more than one course at the 200 level and no more than two at the 500 level may be taken.

MASTER'S PROGRAM

The normal requirement for the Master's degree is five full courses, or the equivalent, of which at least three (including the thesis where applicable) must be at the 500 level. With departmental approval, the remaining two courses may be selected from those offered at the senior undergraduate level.

DOCTORAL PROGRAM

The period of formal study and research required in the Ph.D. program will be at least two years of full-time study (or the equivalent) beyond the Master's degree.

The thesis will ordinarily carry a weight of about half of the total requirement of 10 full courses or the equivalent.

Ordinarily, all courses taken for credit towards the Ph.D. degree must be at the 500 or 600 level.

EXAMINATIONS

Final examinations in courses will be held at the times indicated in the Academic Schedule. Graduate students must obtain grades that meet the standards outlined in the Academic Standing section of this Calendar, and that satisfy the specific requirements of the department concerned.

Special Examinations

A graduate student who is unable to write a final examination because of illness or other circumstances beyond his control, or whose performance on the examination has been impaired by such circumstances, may apply to write a special or deferred final examination.

Such an application will be considered only if it is submitted in writing to the Dean of Graduate Studies within two weeks of the examination, and if it is fully supported, in the case of illness, by a medical certificate or, in other cases, by appropriate documents.

Supplemental or other grade-raising examinations are not ordinarily permitted for students registered in the Faculty of Graduate Studies. Graduate students may, however, repeat a course at the time of the next regular offering to obtain higher standing.

Oral and Comprehensive Examinations

The chairman of the department is responsible for announcing (at least two weeks in advance) the date, place, and time of a comprehensive examination. He will also appoint an examining board according to guidelines laid down by the Faculty of Graduate Studies.

If a comprehensive examination is graded *Unsatisfactory,* the department may permit the candidate to repeat the examination. If the examination is graded *Unsatisfactory* for a second time, a request by the department that the candidate be allowed to continue in the program would require the approval of the Executive Committee of Graduate Studies.

Master's Examinations

In addition to any examination which may be required in individual courses, a Master's candidate who is writing a thesis will be expected to undertake either an oral defence of the thesis or a comprehensive examination in his field of specialization, or both. The thesis must be submitted, in examinable form, at least two weeks in advance of the thesis examination. When the degree is taken by course work, a comprehensive examination may be required. It is important to note that individual departments may have additional or particular requirements.

Doctoral Examinations

Doctoral candidates may be asked to pass a qualifying examination at the beginning of their residence at Carleton.

A comprehensive examination covering prescribed fields will normally be undertaken one year prior to the thesis presentation. This examination (oral or written, or both) may include any material considered fundamental to a proper comprehension of the field of study.

After the thesis has been received and approved, a final oral examination on the subject of the thesis and related fields will be held. Such thesis examinations will be scheduled upon receipt of theses which must be submitted at least four weeks in advance of the date of the examination.

GRADING SYSTEM

Carleton University employs the 12-point system of letter grades to represent standing in graduate lecture courses, directed studies, seminars, tutorials and research essays. The letter grades used, and the grade point equivalents, are as follows:

A+	12	B+	9
A	11	B	8
A—	10	B—	7
C+	6	D+	3
C	5	D	2
C—	4	D—	1

Under certain defined circumstances, *notations* are used instead of letter grades to represent standing. The only notations permissible in the Faculty of Graduate Studies are the following:

- Comprehensive examinations are graded *Pass With Distinction, Satisfactory,* or *Unsatisfactory.*

- The Master's thesis is graded *Pass With Distinction, Satisfactory,* or *Unsatisfactory,* or it may be assigned a letter grade. The oral defence is graded *Satisfactory* or *Unsatisfactory.*

- The Doctoral thesis and its oral defence are each graded *Satisfactory,* or *Unsatisfactory.*

- A notation of *Incomplete* may, subject to the approval of the chairman of the department, be assigned to a course in which the student has been granted the privilege of submitting an assignment after the final deadline date. This notation of *Incomplete* will be permissible only in exceptional cases (e.g. medical or other special reasons) and must be replaced with a letter grade within 30 days of the end of classes. If the notation of *Incomplete* is not changed to a letter grade (through the regular change of grade procedures) within 30 days of the end of classes, the notation will remain as a permanent entry for that registration in the course. However, the student may register to repeat the course in order to obtain letter grade credit in the subject.

- A notation of *Absent* will be assigned to any course in which the student failed to attend the final examination. If the student explains his absence (in writing) to the Dean of Graduate Studies within 14 days of that examination, he may

be granted the privilege of undertaking a special or deferred examination. The notation of *Absent* will also be assigned where a student has terminated a course without formally withdrawing from the course prior to the end of classes.

- If a *thesis or research essay* is not completed by the end of the period of registration, a notation of *In Progress* will be recorded. This notation must be replaced by an appropriate final notation or grade (as specified above) after the thesis or research essay has been examined. In cases where a student has registered in a research essay or a thesis, without completing it, and later undertakes course work to complete the degree program — or loses graduate student status in his program — the notation *In Progress* will be changed to *Incomplete*.

ACADEMIC STANDING

Qualifying Year

The general regulations governing academic standing in the Qualifying Year conform to those of the Master's program.

Master's Program

A grade of B— or better must normally be obtained in each course counted towards the Master's degree. A candidate may, with the recommendation of his department, be allowed a grade of C+ or C (but not C—) in one full-course or each of two half-courses.

Full-time Master's candidates who fail to achieve a weighted grade point average of 6.5 after two terms of study will be required to withdraw from the program. In the event of special or extenuating circumstances, the student may apply to the Executive Committee of Graduate Studies for permission to continue in the program.

A part-time Master's student who fails to achieve or maintain a weighted grade point average of 6.5 after completing two full-courses (or equivalent) will be required to withdraw from the program.

Doctoral Program

Doctoral students must obtain, normally, a grade of B— or better in each course counted towards the degree.

THESIS REQUIREMENTS

Master's Thesis

The Master's thesis should embody the results of successful scholarly research in a specialized area. It should exhibit the candidate's knowledge of recognized techniques of investigation and critical evaluation, and be presented in an organized and systematic way.

Departments may undertake periodic evaluations of a student's progress in his or her thesis or research essay, if they so choose, to determine whether the student's progress is satisfactory.

Candidates are ordinarily required to undertake an oral examination on the thesis. Notice of this examination will be given at least two weeks in advance by the chairman of the department.

The Master's thesis will be examined by a board consisting of at least three members, including the thesis supervisor, the chairman of the department concerned, and an examiner from a department other than that of the candidate.

The constitution of the examining board will be announced by the chairman of the department concerned.

Thesis weight (one to two full-courses) must be identified at the time of initial registration. A change in the thesis weight at a later date would require the approval of the Executive Committee of Graduate Studies.

Doctoral Thesis

The Doctoral dissertation must report, in an organized and scholarly fashion, the results of original research. The thesis must be a contribution to knowledge, and must demonstrate the candidate's ability to undertake sustained research and to present his findings in an appropriate manner.

Departments may undertake periodic evaluations of a student's progress in his or her thesis or research essay, if they so choose, to determine whether the student's progress is satisfactory.

The dissertation must be successfully defended at an oral examination. Notice of this examination will be given at least two weeks in advance by the Dean of the Faculty of Graduate Studies.

The Ph.D. dissertation will be examined by a board consisting of at least five members, including the thesis supervisor, an examiner from a department other than that of the candidate, the members of the candidate's advisory committee, the Dean of the Faculty of Graduate Studies, and an external examiner who is a recognized authority in the subject of the thesis.

The constitution of the examining board will be announced by the Dean of the Faculty of Graduate Studies.

Thesis weight (ordinarily about half of the total Ph.D. program requirement of ten full courses) must be identified at the time of initial registration. A change in the thesis weight at a later date would require the approval of the Executive Committee of Graduate Studies.

Deadlines

A Master's student expecting to graduate at the Spring convocation must submit his thesis or dissertation, in examinable form, to his supervisor by the 29th of April. A Master's student

expecting to graduate at the Fall convocation must submit his thesis by the 1st of October.

A Ph.D. student expecting to graduate at the Spring convocation must submit his thesis or dissertation, in examinable form, to his supervisor by the 1st of April. A Ph.D. student expecting to graduate at the Fall convocation must submit his thesis by the 4th of September.

Specifications

The candidate must submit FOUR typewritten copies (original and three carbons or acceptable duplicated copies) and must comply with special departmental requirements governing the form of the thesis, including methods of bibliographical entry, use of diagrams, tables, and the like.

Abstracts

Each thesis or dissertation must be accompanied by a suitable abstract. The abstract of a Master's thesis should not exceed 150 words, while the abstract of a Doctoral thesis may be up to 600 words in length.

Procedures

For information regarding style, pagination, copyright, certification, acceptance, grade and size of paper, abstracts, reproduction, microfilming, binding, constitution of the examining board, and the like, the candidate should consult his department.

The candidate is expected to notify his supervisor and the chairman of the department (at least two weeks in advance) of the date on which he intends to submit FOUR copies of his completed thesis. The thesis examination and defence will be scheduled and announced at least two weeks in advance.

LANGUAGE REQUIREMENTS

Some graduate programs require a reading knowledge of one or more languages other than English. Language requirements will be prescribed by the departments according to departmental regulations and the needs of their students.

ADVISORY COMMITTEES (Ph.D.)

The work of each doctoral candidate will be assisted by an advisory committee of faculty members who will aid him in his preparation for the final comprehensive examination and assist in the evaluation of the thesis and oral examinations.

COURSE CHANGES

A *course change* is the addition or deletion (dropping) of one or more individual courses by a registered graduate student. A course change is the only acceptable procedure for revising or correcting a graduate student's registration. All course changes must be made on prescribed Course Change forms available at the departmental offices or the Graduate Studies Office.

A part-time student who is registered in two courses and drops one of these may be entitled to a *pro rata* fee credit or refund, depending on the length of time elapsed since the beginning of the term.

The deadline dates for course changes are stipulated in the Academic Schedule of this Calendar.

WITHDRAWAL

A graduate student wishing to terminate his registration in a graduate program (that is, drop all courses) must complete the prescribed Withdrawal form (or apply in writing to the Dean of Graduate Studies) and return his identity card.

When a student officially withdraws with the approval of the Dean of Graduate Studies, a refund of fees will be calculated on a *pro rata* basis as of the date of receipt of the Withdrawal form (or letter) and the identity card. Credit for fees or refunds will depend on the date of withdrawal, the amount of fees paid, and the length of time elapsed since the beginning of the term.

Graduate students are cautioned that there is no procedure at Carleton University for direct "mid-term" transfer from one graduate program to another. Similarly, there can be no direct transfer to or from under-graduate or Special Student status. Any candidate who elects to change programs after registration (and before the last date of late registration) will be required to *withdraw* from the first program and then *register* in the second. The *pro rata* refund of *fees* calculated as a result of withdrawal from the first program can, of course, be applied against the new fee assessment for the second program.

A registered candidate who completes his degree or diploma requirements prior to the last day for withdrawal in any term (as specified in the Academic Schedule) is *required* to withdraw formally. A candidate whose degree program has been completed is not eligible for further registration in the Faculty of Graduate Studies (unless, of course, the candidate has been admitted to some other graduate program).

TIME LIMIT

Master's Program

Full-time: a full-time Master's candidate must complete his degree requirements within *six terms* of registered full-time study AND within an elapsed period of *three calendar years* after the date of initial registration.

Part-time: a part-time Master's candidate must complete his degree requirements within an elapsed period of *six calendar years* after the date of initial registration.

Combined full-time and part-time: A Master's candidate who elects to complete his program by a combination of full-time and part-time study is governed by the following elapsed-time limitation: *five calendar years* if the candidate is registered as a full-time

student for two or three terms and part-time for the balance; *four calendar years* if the candidate is registered four or five terms as a full-time student and part-time for the balance.

Doctoral Programs

Full-time: a full-time Ph.D. candidate who is admitted on the basis of a Master's degree (i.e., with a program of ten full courses or the equivalent) must complete the Ph.D. degree requirements within *twelve terms* of registered full-time study AND within an elapsed period of *six calendar years* after the date of initial Ph.D. registration.

Part-time: a Ph.D. candidate who undertakes the program by a combination of full-time and part-time study must complete the degree requirements within an elapsed period of *eight calendar years* beyond the Master's level.

Extension of Time Limit

In exceptional cases, an extension of time (one or two terms) may be granted to a candidate whose recent progress (as judged by the department) has been otherwise satisfactory. Requests for extension of time should be directed to the Dean of Graduate Studies *through the department concerned.*

CONTINUOUS REGISTRATION

Any candidate who remains unregistered in his degree program for a period longer than twelve months (three terms) will lose his graduate student status.

Any candidate (full-time or part-time) who, after initial registration in a thesis or research essay, fails to register in at least two out of every three consecutive terms will lose his graduate student standing and will forfeit his eligibility to register. Such a candidate may, of course, apply for re-admission.

OFF-CAMPUS RESEARCH

In special cases it may be possible for a registered full-time graduate student to arrange to undertake full-time studies or research at another institution or in the field. It should be understood that such activity would apply only to a *part* of the total program and that the off-campus period would not normally exceed twelve months.

Requests for special permission to undertake full-time off-campus study or research must be submitted, *well in advance,* to the Dean of Graduate Studies through the department concerned. Such requests should include the following information:

- a detailed statement of the research proposal and of the specific arrangements that are proposed for the supervision and direction of the work.

- an explanation of the reasons why the work cannot be satisfactorily undertaken while on campus at Carleton.
- a description of the laboratory and/or research facilities that are available at the proposed off-campus location.
- a written statement from a responsible official (e.g. on-site supervisor or director) of the outside institution confirming that the proposed arrangements are satisfactory and that the candidate will be able to undertake independent research.
- a time-schedule for the proposed research work.
- a statement of the candidate's expected sources of financial support.

INTER-UNIVERSITY CO-OPERATION IN GRADUATE INSTRUCTION

Under certain circumstances it is permissible for a student admitted to a graduate degree program at one university to follow approved credit courses at another university. In particular, a *full-time* graduate student registered at Carleton may be granted permission to follow a course at the University of Ottawa. All interested students should consult the chairman of their department, division, institute, or school *prior to registration* in order to obtain further information on conditions of eligibility, procedures, and the like.

APPEALS

Within two weeks of the release of grades or the announcement of comprehensive examination results or thesis results, a graduate student may request, through the Dean of the Faculty of Graduate Studies, that one or more of his grades or results be reviewed.

A graduate student also has the right to appeal decisions made concerning his graduate status or any other ruling related to his program of studies.

All such appeals are to be made in writing, with an explanation of the pertinent circumstances, to the Dean of the Faculty of Graduate Studies. The appeal and the reply of the department concerned will be subsequently considered by the Executive Committee of Graduate Studies.

GRADUATION

On the recommendation of the Faculty of Graduate Studies and with the approval of the Senate of the University, degrees are conferred by the Chancellor. Convocations for the conferring of degrees are ordinarily held in the spring and fall of each year.

Students expecting to graduate at the Spring convocation must apply for graduation in the Graduate Studies Office by the 1st of February. Those expecting to graduate at the Fall convocation must apply by the 7th of September.

Academic Dress

The academic dress of Carleton University is a compromise between the style of hoods outlined in the American Intercollegiate Code and the dress of the ancient foundation of Britain and America.

The Master's hood, made of black silk, is of simple or Oxford shape with an open lining of two chevrons (red and black) on a silver field. The border of the hood denotes the degree granted, according to the following colour combinations: Arts — white; Science — golden yellow; Social Work — cream; Engineering — orange. The Master's gown is of full style, made of black silk or rayon, with full gathered yolk behind and closed sleeves with an opening at the elbows.

The Doctor of Philosophy hood is also made of silk, but completely opened to show the lining, and provided with a purple border. The Doctoral gown has the same style as the Master's and is made of fine royal blue cloth with facings of a light blue silk.

The gown of the Honorary Doctorate of Laws or of Science is a blue robe with bell-shaped sleeves, made of fine royal blue cloth with facings and sleeves in light blue silk. The hood is made of the same material as the gown, has the same lining as that for the degrees granted by examination, and is bordered with purple for the Degree of Doctor of Laws, dark red for the Degree of Doctor of Science, and orange for the Degree of Doctor of Engineering.
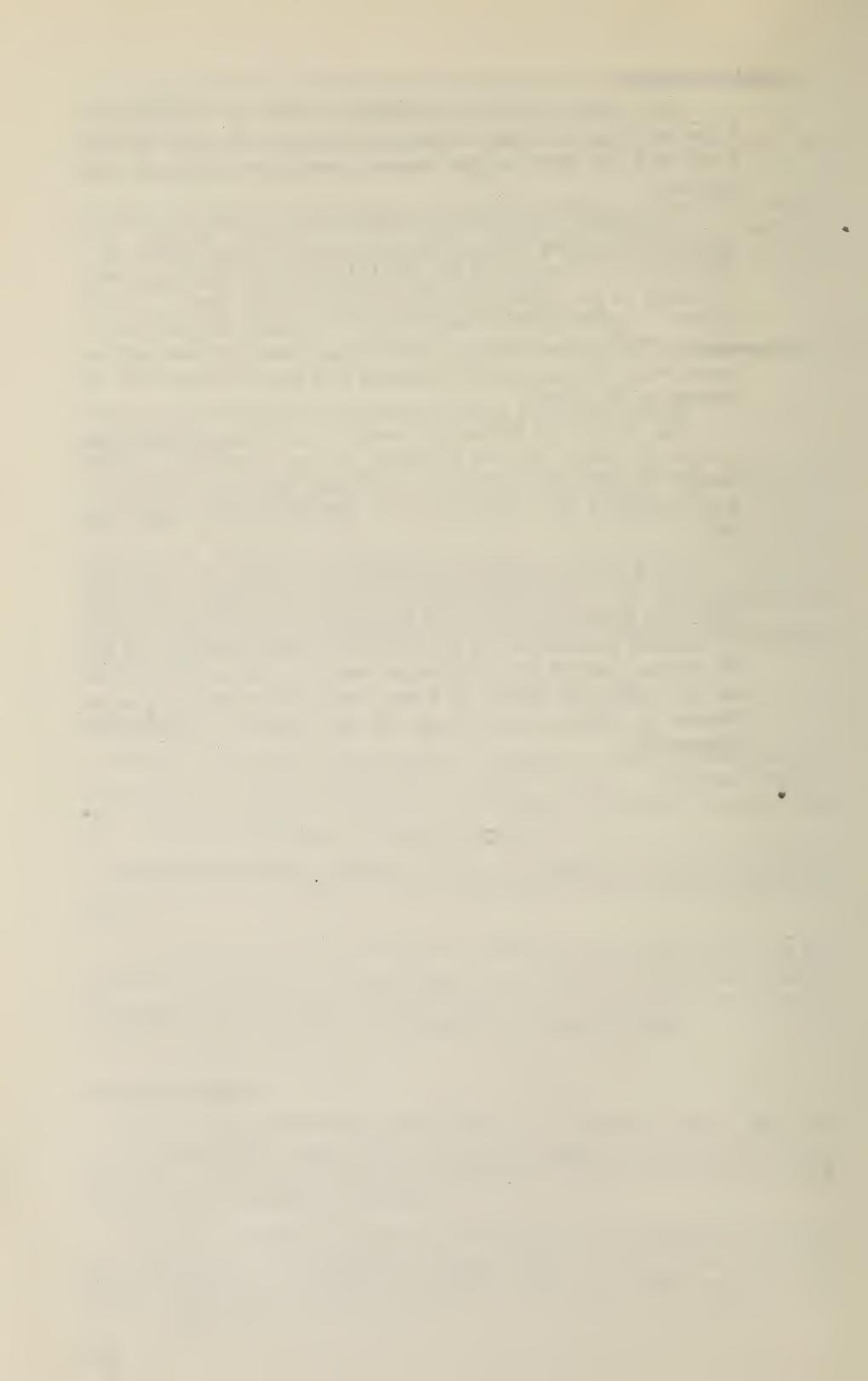
CARLETON UNIVERSITY

Faculty of Graduate Studies

1973-74 FEES

This supplement is issued to replace, in part, the fees section (pages 27-29) of the 1973-74 Graduate Studies Calendar.

The following Government of Ontario announcement concerning tuition fees for 1973-74 was received by Carleton University:

Extract from the letter of the Minister of Colleges and Universities dated Feb 28, 1973: *"I would also like to announce that, in accordance with the recommendations of the Committee on University Affairs, the graduate formula fee for 1973-74 will be retained at the same level as for the current year. At the same time, permission to use operating funds for the awarding of bursaries to graduate students in the third consecutive term will be extended to August 31, 1974."*

Accordingly, the Board of Governors of Carleton University, approved the following fee structure for 1973-74 which, with the exception of the change in the fees for students in the Master of Social Work program and the increase in the fee for athletics, is the same as the 1972-73 fee structure:

FULL-TIME STUDENTS

Graduate Qualifying Year, Diploma in Public Administration and first
year **Master of Social Work -** fee assessment for the academic year:

Tuition	$580.00
Students' Association	21.00
Athletics	30.00
Health and Counselling	12.00
University Centre	16.00
TOTAL COMPOSITE FEE (two terms):	$659.00

Master's Degree Programs (first year of full-time study) **Doctoral
Degree Programs** (first and second year of full-time study) - fee assessment on a per term basis:

Tuition	$292.50
Students' Association	7.00
Athletics	10.00
Health and Counselling	4.00
University Centre	5.35
TOTAL COMPOSITE FEE (per term):	$318.85

Master of Social Work Program - second year
The Total composite fee for students in the second year of the MSW
program: .... $637.70 per academic year.

Note: Third Term Tuition Fee Bursaries

Tuition Fee ($292.50) Bursaries will be provided to two categories of
students whose registration in the Fall term of 1973 or Winter term of
1974 or Spring term of 1974 represents a third *consecutive* term of full-
time studies. The categories are:

- Full-time Master's students who initially entered the program in the
  1973 Winter term, 1973 Spring term, or 1973 Fall term;

- Full-time Ph.D. students who initially entered the first or second
  year of the program in the 1973 Winter term, 1973 Spring term, or
  1973 Fall term.

Master's Degree Programs (second or subsequent year of full-time study) and **Doctoral Degree Programs** (third or subsequent year of full-time study) - fee assessment on a per term basis:

Tuition	$152.65
Students' Association	7.00
Athletics	10.00
Health and Counselling	4.00
University Centre	5.35
TOTAL COMPOSITE FEE (per term):	**$179.00**

PART-TIME STUDENTS

All part-time graduate students will be assessed the following fees on a per course basis:

	Full Course	Half Course
Tuition	$113.20	$ 56.60
Students' Association	4.20	2.10
Athletics	6.00	3.00
Health Services	2.00	1.00
University Centre	3.20	1.60
TOTAL COMPOSITE FEE (per course):	$128.60	$ 64.30

Students who require additional time on a *part-time basis* to complete theses or research essays must re-register for each subsequent term of activity. The per-term re-registration fee is equivalent to the prevailing fee assessment for half-course.

FEES

Fees at Carleton University are calculated and assessed on a composite basis to include Tuition, Students' Association, Athletics, University Centre, and Health Services fees and, where applicable, laboratory, graduation, and other fees.

At the time that the Calendar went to press, an approved schedule of fees for the 1973/74 Academic Year was not available. Consequently, the fees below reflect, in part, the Fee Schedule for 1972/73. Current students and students applying for admission, who wish a confirmation of the fee structure for 1973/74, are invited to make enquiries in writing or by telephoning the Graduate Studies Office.

FULL-TIME STUDENTS (1973 fall and 1974 winter terms)

- **Graduate Qualifying Year** and **Diploma in Public Administration** — fee assessment for the Academic Year (fall and winter terms):

Tuition	$ 580.00
Students' Association	21.00
Athletics	24.00
Health and Counselling	12.00
University Centre	16.00
TOTAL COMPOSITE FEE (two terms):	$ 653.00

- **Master's Degree Programs** (first year of full-time study) and **Doctoral Degree Programs** (first and second year of full-time study) — fee assessment on a per term basis:

Tuition	$ 292.50
Students' Association	7.00
Athletics	8.00
Health and Counselling	4.00
University Centre	5.35
TOTAL COMPOSITE FEE (per term):	$ 316.85

- **Master's Degree Programs** (second or subsequent year of full-time study) and **Doctoral Degree Programs** (third or subsequent year of full-time study) — fee assessment on a per term basis:

Tuition	$ 152.65
Students' Association	7.00
Athletics	8.00
Health and Counselling	4.00
University Centre	5.35
TOTAL COMPOSITE FEE (per term):	$ 177.00

PART-TIME STUDENTS

All part-time graduate students will be assessed the following fees on a per course basis:

	Full Course	Half Course
Tuition	$113.20	$ 56.60
Students' Association ..	4.20	2.10
Athletics	4.80	2.40
Health Services	2.00	1.00
University Centre	3.20	1.60
TOTAL COMPOSITE FEE (per course):	$127.40	$ 63.70

Students who require additional time on a *part-time basis* to complete theses or research essays must re-register for each subsequent term of activity. The per-term re-registration fee is equivalent to the prevailing fee assessment for a half-course.

THIRD CONSECUTIVE TERM TUITION FEE BURSARIES

Bursaries of up to $300 may be provided to two categories of students whose registration in the Fall term of 1973 or Winter term of 1974 or Spring term of 1974 represents a third *consecutive* term of full-time studies. The categories are:

- Full-time Master's students who initially entered the program in the 1973 Winter term, 1973 Spring term, or 1973 Fall term;

- Full-time Ph.D. students who initially entered the first or second year of the program in the 1973 Winter term, 1973 Spring term, or 1973 Fall term.

FEE PAYMENT

Fees are due and payable at the time of registration. All fee payments are governed by the following regulations:

- If fees are assessed on a per term basis then the fee for each term is due and payable during the regular registration period for that term.

- If fees are assessed on a calendar year (12 months) or academic year (8 months) basis then the student may elect to defer payment of a *part* of the fee. However, if the fee payment is not made in full at the time of registration, a deferred payment fee will be assessed.

- Scholarships, fellowships, bursaries, assistantships, and loans administered by the University shall be applied first to fees provided this is not contrary to the terms of the award.

- Personal cheques will be accepted for the payment of accounts, but the University reserves the right to cancel this policy if it is abused. A service charge of $5.00 will be assessed for each cheque returned to the University as non-negotiable for any reason. Students are requested to provide their own cheque blanks when making payments.

- A statement of tuition fees paid may be obtained for taxation purposes by applying to the Business Office in February.

SPECIAL FEES

Late Registration Fees

Full-time students: $10.00 first week after the regular registration period.

$15.00 second and third weeks after the regular registration period.

Part-time students: $5.00 per course after the regular registration period.

Examination Fees

Special final examinations written at Carleton University: $10.00 per paper.

Examinations written at a university centre other than Carleton University (when permitted): $20.00 per paper.

Transcript Fees

All students are entitled to two free copies of their official transcript. Additional copies will be issued at a charge of $1.00 for the first, $.50 for the second, and $.25 for each further copy (at any one time of ordering).

Locker Fees

A fee of $2.00 will be charged for the use of locker space. This fee is not refundable after the last date of late registration.

Parking Fees

A limited amount of parking space is available on the Carleton campus. Details of the University's parking regulations and fees may be obtained from the Business Office.

Parking arrangements and fee payments are normally made at the time of Registration.

Deposit — Gowns and Hoods

At each convocation, the University makes available to graduating students the appropriate academic regalia. A $25.00 deposit is required, which will be refunded when the regalia are returned.

FEE REFUND OR CREDIT UPON WITHDRAWAL

A graduate student wishing to terminate his registration in a graduate program (that is, drop all courses) must complete the prescribed With-

drawal form (or apply in writing to the Dean of Graduate Studies) and return his identity card. When a student officially withdraws with the approval of the Dean of Graduate Studies, a refund of fees will be calculated on a *pro rata* basis as of the date of receipt of the Withdrawal form (or letter) and the identity card. Credit for fees or refunds will depend on the date of withdrawal, the amount of fees paid, and the length of time elapsed since the beginning of the term.

A part-time student who is registered in two courses and drops one of these may be entitled to a *pro rata* fee credit or refund, depending on the length of time elapsed since the beginning of the term. All course changes must be made on prescribed Course Change forms available at the departmental offices or the Graduate Studies Office.

DELINQUENT ACCOUNTS

If a student has any overdue account (fees, library charges, traffic violation fines, or other incidental bills with the University), his examination results will be withheld, his academic file will be sealed, and he will not be permitted to register again until such accounts have been paid in full by cash or certified cheque. Moreover, other measures, as may be prescribed by the Senate or the Board of Governors, may also be instituted.

GENERAL INFORMATION

LIBRARY REGULATIONS

All persons registered at the University are entitled to use the Library on a year round basis. Graduate students may borrow most books for a period of up to four weeks, although some books are placed on "Reserve" and may only be borrowed for one week, or on an overnight basis. Alumni of Carleton University, on payment of the appropriate fee, and graduates and students of other universities, on payment of the appropriate fee, and at the discretion of the University Librarian, may have limited borrowing privileges.

If books are not returned to the Library when due, fines will be charged.

As a condition of use of the Library facilities, all users must submit books, brief cases, bags, etc. for inspection at the exit, if requested to do so.

STUDENT PARTICIPATION IN ACADEMIC AFFAIRS

New University Government (N.U.G.) is a governing system wherein all faculty members and some students are formally involved in the Government of the University at the departmental, faculty board and Senate levels.

The first level is election to the faculty and departmental boards through a general election among all the graduate students in the various departments. From here it is theoretically possible to get support from a majority of faculty and get elected to Senate and the Board of Governors. As this has happened only twice, the Students' Association is investigating the possibility of direct election by students to these bodies.

STUDENT GOVERNMENT

Carleton University Students' Association

All registered students, full- and part-time, are members of the Students' Association. The Students' Association has two main functions — providing services to students and representing their views on a wide range of interests both internally and externally.

The legislative body for the Students' Association is Students' Council. Elected representatives from each faculty serve for 12 months with the two graduate representatives elected by the Graduate Students' Association in October. The Students' Council President, Finance Commissioner and undergraduate representatives are elected in the Spring and the rest of the executive is internally elected shortly thereafter.

As services for all students, the Students' Association publishes a weekly newspaper, a course evaluation guide, a literary magazine and runs a licensed A.M. carrier-current Radio Station. It also runs a pub five nights a week, a community switchboard, co-op houses, day care centres, clubs, theatre programs and so on. Each year new services are offered depending on the orientation of the current Students' Council.

One major part of the Students' Association is the University Centre. The Unicentre is run for the whole university community by the Students' Association which employs an Administrative Director to take care of the day-to-day operations. Policy is set by the Students' Council. The Unicentre has a wide range of facilities, including a variety store, music/reading rooms, coffee house, games areas, concert hall, cafeterias, the radio station, newspaper office, dark rooms, Council offices and, of course, the ubiquitous pubs.

As far as representing student interests go, the Students' Association belongs to the Ontario Federation of Students to look after provincial interests and is considering joining the National Union of Students for national issues. On campus the Students' Council each year tackles a number of issues which have ranged from university government to reviewing athletics to the financing of post-secondary education. The Students' Association offices are located in Room 508 of the Unicentre and can be reached by phone at 231-4380.

The Graduate Students' Association

The Graduate Students' Association comprises all students registered for a program in graduate studies at the University. Supported by funds obtained from the Carleton University Students' Association, the activities of the Graduate Association include publications, social activities, a program of guest speakers, and support for graduate activities at all levels within the University.

The aim of these programs is to provide opportunities for graduate students to communicate with each other, and with the entire university community about issues and problems of particular concern to graduate students.

There are three elective executive positions (President, Internal and External Vice-Presidents) and an elected council consisting of representatives from each graduate department. In addition, there are two graduate representatives to the Students' Council. Elections generally take place in the Fall term.

The current executive welcomes the interest and assistance of all graduate students.

THE ALUMNI ASSOCIATION OF CARLETON UNIVERSITY

The Alumni Association was founded in 1949. Its objectives are "to contribute to the development of the University, academically and otherwise, and to the effectiveness with which it fulfils its role in society; to establish and maintain mutually beneficial relations and communications between the University and its alumni, and amongst the alumni members themselves; and to foster an understanding of the function of the Alumni Association amongst the undergraduates of the University."

Membership is open to all graduates and to former students of the University who have successfully completed the requirements of a full year in a recognized course leading to degree, diploma or certificate.

The Association maintains address records, publishes a magazine, *The Carleton Alumneye,* for distribution to all alumni, and sponsors a program of events and services for alumni and students. The Association also assists branches and informal groups in major centres in North America.

HOUSING AND FOOD SERVICES

Residences

There are currently five residence complexes on the Carleton campus accommodating a total of 1,317 students in men's, women's and co-educational residences. Each building is provided with lounge, study, and storage areas, and library, television, and music rooms.

Residence accommodation is for full-time students, graduate and undergraduate. There is no provision for married couples.

The cost of room and meals for the academic year is $1,027 for a single room and $952 for a place in a double room. A $25 deposit must accompany all applications for residence accommodation; this deposit is refundable only if the applicant fails to qualify for admission to Carleton University or is not allotted a place in residence.

For further information and application forms, contact the Student Housing Office (University Commons).

Off-Campus Housing

An off-campus housing information service is available to assist students who are unable to obtain or do not wish to take up on-campus residence accommodation. This service has been established to assist out-of-town students, but is in no way a rental agency.

For further information, contact the Student Housing Office (University Commons).

Food Services

All students may use the residence dining facilities (University Commons) on an occasional basis or by purchasing a term meal ticket. The Commons also has a snack bar.

Additional dining and cafeteria facilities are located in the University Centre and the Loeb Building.

ATHLETICS AND RECREATION

The Athletics and Physical Recreation program at Carleton, which plays an important role in maintaining and enhancing the University spirit, is co-ordinated by the Athletic Board, a committee consisting of students, faculty members, and administrators.

At the intercollegiate level, Carleton is a member of the Ontario Universities Athletic Association. Carleton varsity teams, known as the Ravens, participate in basketball, football, hockey, soccer, skiing, badminton,

tennis, golf, fencing, curling, wrestling and gymnastics. Graduate students are eligible for intercollegiate athletics, subject to league regulations.

The intramural program includes flag football, cross-country, basketball, broomball, volleyball, badminton, swimming, curling and hockey. Some of these sports are co-educational although most are played separately by men and women.

Carleton's athletic facilities currently include football and soccer fields, outdoor hockey and skating rinks, and a gymnasium complex which includes such facilities as squash courts, weight-lifting room, combatives room, gymnastics and multipurpose room, and a gymnasium. These facilities are available for use by Carleton students for organized and recreational sports activities.

THE UNIVERSITY CENTRE

The University Centre houses the following facilities: food services, lounges, main hall, meeting-dining rooms, variety store, barber shop, table tennis and billiards tables, Students' Council offices, Faculty Club, music listening room, reading room, health and counselling services, etc. The Centre is for the use of all members of the University community.

COUNSELLING AND HEALTH SERVICES

Counselling and Health services are provided to protect and improve the physical and mental health of the students and of the university community. Its responsibilities are to provide treatment, to consult and advise on matters of health and to ascertain the fitness of students to perform academic work. When the necessary service cannot be provided by the program, the staff will endeavour, through referral, to make available what is required. The nature of the service demands that the confidentiality of records and information be respected and maintained.

The Counselling and Health services have regular hours and are staffed by physicians, nurses, counsellors, and consulting psychiatrists.

Health Regulations

- Medical insurance is compulsory for all full-time students. At the time of registration students must provide Counselling and Health Services with the company or insurance agent, the individual and group number, and the name (including initials) of the subscriber.
- Overseas students are required to have hospital insurance. Those without coverage should make application for the Ontario Health Insurance Plan during registration.

Students who object to the above requirements on conscientious grounds must consult the University physician and provide a written statement giving the basis for such objection.

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PLACEMENT

The Placement Office maintains liaison with local employers as well as employers from all across Canada on opportunities for graduates, graduating students and students seeking summer employment.

Many of the companies conduct recruiting visits on-campus and these visits usually commence in early November and continue through to the end of February. Information concerning companies and their representatives may be obtained and appointments with company representatives may be arranged through the Placement Office.

A career information library is maintained in the Placement Office. Holdings include current material on individual firms, career monographs, university calendars, employer directories, periodicals and newspapers.

Regular notices, including Government opportunities, are published and posted on employment notice boards.

AWARDS AND FINANCIAL ASSISTANCE

GENERAL INFORMATION

Awards Policy

Scholarships and fellowships are awarded on the basis of academic standing and demonstrated potential for advanced study and research. Unless otherwise stated, awards are for one year only, but application for renewal will be considered in open competition.

Awards are ordinarily offered only to applicants who have been admitted to full-time graduate studies. Students admitted to the Qualifying Year program are not eligible for major scholarships or fellowships.

In order that awards may be equitably distributed, no student may hold more than one major fellowship or scholarship in a given year. A major award is defined broadly as $2,000 or more for the academic year or $3,000 for a calendar year.

Holders of awards must pay regular tuition fees unless otherwise stated.

Full-time graduate students at Carleton are expected to comply with the following procedures:

- Any full-time graduate student who accepts a scholarship or award that is not directly administered by Carleton University must inform, without delay, his departmental chairman and the Dean of Graduate Studies. This requirement applies to *any* awards or assistance offered by *any* other agency or institution.
- Any full-time graduate student who accepts part-time employment outside the university is required to inform his departmental chairman and the Dean of Graduate Studies *in writing* prior to undertaking the work.
- Any full-time graduate student who obtains part-time employment (teaching, research, or service assistantship) in a university department other than his own is required to inform his departmental chairman *prior to undertaking the work.* This requirement also applies to employment obtained in an administrative department (e.g. Library, Business Office, Registrar's Office, Residence).

Application Deadlines

The 1st of March is the last date for receipt of applications for admission from candidates who wish to be considered for the initial award (April 1) of financial assistance (including fellowships, scholarships and assistantships) administered by Carleton University. Supporting documents (e.g. transcripts and letters of reference) must be received by the 15th of March.

Candidates whose applications are received after the March 1 deadline date may be eligible for the award of a fellowship, scholarship or assistantship by *reversion*. Awards by reversion are normally considered on or about the 15th of May, 15th of August, and 1st of October.

Methods of Payment

Fellowships, teaching assistantships, and research assistantships administered by Carleton University will be paid, through the University Payroll Office, on a monthly basis — with the first installment on the 1st of October. Scholarships awarded for the academic year (fall and winter terms) are ordinarily paid in two equal installments: 1st of October and 15th of January. Scholarships awarded for the calendar year are ordinarily paid in three equal installments: October 1st, January 15th and June 15th.

Other Awards

A number of national and provincial organizations award fellowships and scholarships tenable at Carleton University, (e.g. the Canada Council, the National Research Council, etc.). Application procedures and regulations concerning fellowships awarded by agencies other than Carleton University are given in the description of each of these awards.

In addition, a large number of foundations, companies, fraternal organizations, and other agencies offer fellowships and scholarships. Prospective graduate students should consult the biennial publication of Statistics Canada entitled *Awards for Graduate Study and Research* which contains information concerning all such awards, their terms, dates and methods of application. Students should also consult the publication entitled *Fellowships and Scholarships offered by Private Donors and Foreign Governments for Canadian Students,* obtainable from the Association of Universities and Colleges of Canada, 151 Slater Street, Ottawa K1P 5N1. These publications are also available for reference in the Graduate Studies Office.

Eligibility

In the case of fellowships, grants, scholarships, etc., for which students must make application, the onus concerning eligibility rests solely on the student. If it should be discovered that a student is unqualified for any reason, the funds already received must be returned by the student, with the University assuming no responsibility.

In the case of awards, for which application by students is not required (such as Epstein Scholarships, Carleton Fellowships, and Graduate Scholarships), the onus for eligibility rests with the departments concerned.

Students are urged to consult carefully the brochures and announcements which specify the conditions associated with tenure of individual awards. This information is available in the Graduate Studies Office and in the office of the chairman of the department concerned.

AWARDS ADMINISTERED BY CARLETON UNIVERSITY

Carleton Fellowships

The Carleton Fellowships, ranging in value from $1,500 to $1,700 per term (fall, winter and spring terms), are awarded annually to outstanding graduate students. The fellowship is comprised of a scholarship in combination with a teaching or research assistantship. Recipients must be enrolled full-time in each term of the award.

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Carleton Fellowship winners are expected to undertake responsibilities as teaching or research assistants during tenure of the Fellowship — the work load associated with such responsibilities is limited to a maximum of 10 hours per week including time devoted to preparative work, marking or grading set assignments etc.

Application is not required. Recipients are chosen annually by the Awards Committee from the list of candidates recommended by each department concerned.

The David and Rachel Epstein Foundation Scholarships

Part of the income from the David and Rachel Epstein Foundation Fund has been designated to provide scholarships for outstanding graduate students at Carleton University.

Established in 1970, the scholarships are awarded annually by the Scholarship Selection Committee.

The value of the Scholarships is to be established from year-to-year with the amounts adjusted so that the scholarships in combination with a teaching or research assistantship, if any, will cover living expenses, tuition fees and travel expenses.

Application is not required. Recipients are to be chosen from list of candidates recommended by each department concerned.

Graduate Scholarships

Scholarships ranging in value from $100 to $300 per term are awarded annually to graduate students with high standing as a supplement to other scholarships, fellowships and assistantships. Application is not required. Award winners will be selected from list of nominees recommended by each department concerned.

Graduate Teaching Assistantships

A large number of graduate teaching assistantships, ranging in value up to $1,200 for Qualifying Year, up to $2,200 for Master's, and up to $2,400 for Ph.D. students for a 12-month period of three consecutive terms, are awarded annually in most departments.

Recipients are required to undertake a teaching assignment up to a maximum total of 10 hours per week (the total of 10 hours includes class contact time, if any, time devoted to preparative work, marking or grading set assignments, etc.). In Science and Engineering, the assignment associated with a teaching assistantship is usually that of a laboratory demonstrator or assistant. In the Humanities and Social Sciences, the assignment associated with a TA is usually that of a discussion group leader. In exceptional cases, a teaching assistantship may involve lecture duties.

For information concerning teaching assistantships contact, or write directly to, the chairman of the department concerned.

Graduate Research Assistantships

A number of graduate research assistantships ranging in value up to $2,240 for the academic year (fall and winter terms) and up to $3,360 for twelve months are awarded annually in most departments.

Recipients must accept an assignment as a research assistant under direction of a professor. In many cases the assignment will be in the same area as student's thesis research topic.

For further details contact, or write directly to, the chairman of the department concerned.

Summer Supplements

A number of graduate research assistantships for the four month period from mid-May to mid-September are available in most departments.

A limited number of graduate teaching assistantships are also available in some departments.

For further information contact the chairman of the department concerned.

Paterson Fellowships

From the generous support provided by the Honorable Norman M. Paterson when the School was established in 1966, funds are allocated to support some candidates for the M.A. degree in International Affairs.

All those with high standing who are admitted to this M.A. program are considered as applicants for these fellowships.

Norman Paterson Fellowships in Soviet and East European Studies

Beginning in 1973-74, two fellowships, tenable in the University's Institute of Soviet and East European Studies, will be available to candidates for the M.A. degree in Soviet and East European Studies. These awards are provided through the generosity of Senator Norman Paterson.

The fellowships, which have a value of $4,200 for the calendar year, represent a scholarship in combination with a teaching or research assistantship.

Applicants should have an Honours B.A. (or the equivalent) in Soviet and East European Studies and a reading knowledge of Russian or another Slavic language. Graduates in other disciplines, however, whose records reflect a strong interest in the Soviet and East European area, will also be considered.

Further information and application forms may be obtained by writing to the Director of the Institute of Soviet and East European Studies.

Dafoe Foundation Post-Graduate Fellowship

The Dafoe Foundation will provide a post-graduate fellowship, valued at $3,000, to assist graduate studies conducive to an understanding of international relations during the academic year 1973-74.

Under the terms of the award, graduate studies may be undertaken in such fields as international relations, political science, international or other economics, or diplomatic or other history. The governing consideration is that such studies have relevance to the purpose for which the fellowship was established.

Application forms may be obtained from the Graduate Studies Office at Carleton University. Completed applications for the fellowship must be returned to the Graduate Studies Office before the 15th of March.

R. O. MacFarlane Memorial Book Award

This award is presented annually to an outstanding student registered in a graduate program in the School of Public Administration at Carleton University. The award is named in honour of the late R. Oliver MacFarlane, first Director of the School of Public Administration, 1953-1971.

Residence Fellowships

Residence Fellowships for men and women are available to students of Carleton University. Residence Fellows will be offered free accommodation and meals for one academic year; a Senior Residence Fellow will receive, in addition, a stipend of $200.

Applications are invited from graduate and senior undergraduate students with good academic standing.

Application forms may be obtained from: The Provost of Residences, Carleton University, 1231 Colonel By Drive, Ottawa K1S 5B7, Ontario. Completed applications must be returned to the above address before the 1st of March.

Graduate Bursaries

A full-time graduate student who experiences *unexpected* financial need after completion of five weeks (from the date of most recent registration) may be awarded a bursary of up to $200 for that term (with maximum of $400 for three consecutive terms). Application forms are available from departments.

AWARDS TENABLE AT CARLETON UNIVERSITY

Canada Council Doctoral Fellowships

The Canada Council offers fellowships, ranging in value up to $3,500 for students in the first two years of their program and up to $4,500 for students who have completed the first two years

of their program, for studies and research at the doctoral level in the humanities and the social sciences.

These fellowships are tenable in Canada or elsewhere for a maximum of twelve months, and may be renewed upon application.

Application forms and brochures containing details of the assistance programs available may be obtained from the Graduate Studies Office or from the chairman of the department concerned, or by writing to: The Canada Council, 151 Sparks Street, Ottawa, Ontario.

Students currently enrolled at Carleton University must apply on or before the 11th of December. Other applicants must submit applications to the Canada Council by the 15th of December.

Canada Council Killam Awards

These awards are intended to support a few scholars of exceptional ability engaged in research projects of a far-reaching significance. Career scholars, whether or not attached to a university at time of application, who are permanent residents of Canada, are eligible. Research is supported in any of the social sciences or humanities and inter-disciplinary research linking any of the physical or biological sciences with any of the social sciences or humanities. Applications should be sent to Killam Awards Programme, Canada Council, 151 Sparks Street, Ottawa, Ontario.

Central Mortgage and Housing Corporation Fellowships in Urban Affairs

The Central Mortgage and Housing Corporation annually offers fellowships valued at $3,900 (plus fees and an allowance of $600 for each dependent child) for graduate study and research in a broad range of fields involved in understanding and dealing with urban and regional environment. Among the appropriate fields of study are economics, history, philosophy, geography, psychology, sociology, anthropology, local government and administration, ecology, regional science, transportation, law, urban planning, and environmental studies. Programs of study must, of course, be related to urban affairs.

Applicants must be Canadian citizens or must have been landed immigrants in Canada for not less than 18 months at the closing date of submission of applications to Central Mortgage and Housing Corporation. Candidates for study at universities outside Canada must be Canadian citizens.

Applications must be submitted by the applicant *to the university at which the applicant proposes to study* not later than March 1st. Officials of that university must appraise the application and forward it to Central Mortgage and Housing Corporation. Applications will not be accepted by Central Mortgage and Housing Corporation directly from applicants.

Application forms and additional information may be obtained from the Administrative Officer, Fellowship Committee, Central Mortgage and Housing Corporation, Ottawa, Ontario K1A 0P7.

Commonwealth Scholarships and Fellowships

The Government of Canada, through the Commonwealth Scholarships and Fellowships Committee, annually offers a number of scholarships and fellowships, normally awarded for two years, which cover such expenses as travelling costs, tuition fees, other university fees, and a living allowance, to students of other Commonwealth countries.

Under a plan drawn up at a conference held in Oxford in 1959, these Commonwealth Scholarships and Fellowships are awarded mainly for graduate study, and are tenable in the country making the offer.

Consult the Graduate Studies Office for details of the terms of the awards offered by Canada and other countries, or write to: The Association of Universities and Colleges of Canada, 151 Slater Street, Ottawa, Ontario, K1P 5N1.

Persons intending to apply for the year 1973-74 are advised to enquire not later than mid-October, approximately one year prior to the date of tenure.

National Research Council Scholarships and Bursaries

National Research Council scholarships ($4,050 for 12 months) and bursaries ($3,450 for 12 months) are tenable at Carleton University by students undertaking advanced studies and research in Science, Engineering, Experimental Psychology, and Physical Geography.

Students currently enrolled at Carleton University must apply on or before the 11th of December on prescribed forms which may be obtained from the Graduate Studies Office or from the chairman of the department concerned. Other applicants must submit applications by the 31st of December.

1967 Science Scholarships

The National Research Council annually offers scholarships valued at $5,500 per year (plus a travel grant, a grant to cover academic fees, and a grant to the student's supervisor) for a maximum of four years.

Nominations (including supporting documents) must be sent to the Graduate Studies Office by December 11.

The awards are tenable only at Canadian universities other than those from which the repicients have graduated. Recipients are not permitted to accept other scholarships or to accept any remuneration for demonstrating or instructing.

Nominations, which must be received by the National Research Council not later than the 31st of December, will be forwarded by the Graduate Studies Office.

Further details of the terms of this award may be obtained from the Graduate Studies Office or from the chairman of the department concerned.

Ontario Graduate Fellowships

The Province of Ontario offers graduate fellowships up to the value of $1,500 for an academic year (eight months) plus a summer supplement of $750.

The minimum prerequisite is an Ontario Honours bachelor's degree, or the equivalent. Fellowships are tenable only at Ontario universities, and preference will be given to applicants who are residents of the Province of Ontario.

In accepting an award, a Fellow is required to indicate that he has serious interest in university or college teaching in Ontario. He must undertake a full-time program of graduate study during the tenure of his award.

Application is to be made on prescribed forms which may be obtained from the Graduate Studies Office or from the chairman of the department concerned. The deadline date for application is normally the 15th of February.

The Queen Elizabeth II Ontario Scholarships

The Queen Elizabeth II Ontario Scholarship Fund provides a number of annual awards, valued at $5,000 each, for graduate study and research leading to the Ph.D. degree in the humanities, social sciences, and mathematics.

The scholarships are tenable only at Ontario universities, and preference will be given to candidates who are residents of Ontario.

Further details of the terms of these awards may be obtained at the Graduate Studies Office.

Prescribed application forms are to be completed and submitted to the Dean of the Faculty of Graduate Studies on or before the 1st of December. Nominations made through the Dean of the Faculty of Graduate Studies will be forwarded to the Selection Committee on or before the 15th of December.

Sir John A. MacDonald Graduate Fellowship in Canadian History

The Province of Ontario annually offers the Sir John A. MacDonald Graduate Fellowship, valued at $4,000, for full-time graduate studies and research in the field of Canadian history. The fellowship is tenable only at an Ontario university and will be awarded to a Canadian citizen resident in Ontario.

The fellowship is awarded on the basis of the candidate's academic record and other relevant evidence, the minimum aca-

demic prerequisite being an Ontario Honours bachelor's degree, or the equivalent.

Application forms and additional information can be obtained at the Graduate Studies Office. The deadline date for submission of completed applications to the Chairman of the Department of History is the 15th of January.

Department of National Defence Scholarships

The Department of National Defence annually offers three scholarships valued at $4,000 (plus fees) to support military and strategic studies of interest to Canada, including work on the national aspects of security, studies of strategic theory, alliances and the United Nations, and civil-military relations.

Applicants must be Canadian citizens and must hold an Honours bachelor's degree (or the equivalent) before taking up the award.

The duration of the award is one year, with the possibility of renewal. The awardee may not hold concurrently any other award(s) in excess of a total value of $600 annually.

Application forms and additional information may be obtained from the Director of Awards, Association of Universities and Colleges of Canada, 151 Slater Street, Ottawa, Ontario, K1P 5N1. The closing date for receipt of completed applications is the 1st of March.

Transportation Development Agency Fellowships in Transportation

The Transportation Development Agency awards a number of fellowships valued at $4,200 for 12 months, (Master's and Ph.D. levels), for full-time graduate study in any discipline related to transportation. In addition, tuition fees of up to $700 will be paid.

Applicants must be Canadian citizens or landed immigrants in Canada before January 1. The awards are tenable at any Canadian university but in special circumstances doctoral awards may be approved for tenure outside of Canada. Recipients must enrol in a degree program which includes a thesis requirement.

Application forms may be obtained from the Graduate Studies Office or directly from the Transportation Development Agency. Applications must be submitted to the University by the candidates before February 16. Completed applications will be forwarded to the Transportation Development Agency by the chairman of department concerned and not by the applicant himself. Completed applications must be post-marked no later than March 2.

The International Nickel Graduate Research Fellowships

The International Nickel Company of Canada, Limited, annually offers fellowships for graduate studies and research at a

Canadian university leading to the Master's or Ph.D. degree in one of the following fields: Chemistry or Physics of Metals; Geology (including Geophysics and Geochemistry); Metallurgy (Physical and Extrative); Mineral Processing; Mining.

Each fellowship has a value of $4,500 per academic year ($3,800 payable to the Fellow, and $700 to be at the disposal of the candidate's supervising professor to defray research expenses) for a period not exceeding three years.

Application should be made prior to the 15th of January through the University department concerned. Nominations will be forwarded by the University to the awarding agency.

Bell Canada Centennial Fellowships

Bell Canada annually offers fellowships valued at $5,000 per calendar year ($3,500 to the Fellow and $1,500 to the university) for graduate study in any field of study, preferably in a subject area relevant to the scientific, political, social, or economic needs of Canada.

Candidates must be Canadian citizens or must have held landed immigrant status for at least one year prior to the date of application, and must be graduates of a university or college accepted by the Association of Universities and Colleges of Canada.

The awards are tenable at any Canadian university or college which is a member or affiliate of the Association of Universities and Colleges of Canada.

Consult the Graduate Studies Office for further details of the terms of this award or write to the Association of Universities and Colleges of Canada, 151 Slater Street, Ottawa, Ontario, K1P 5N1.

The closing date for receipt of completed applications is the 1st of March.

Gulf Oil Canada Limited Graduate Fellowships

Gulf Oil Canada Limited annually offers five fellowships, valued at $4,500 ($3,500 payable to the Fellow, and $1,000 to be placed at the disposal of the department in which he is registered), for graduate study and research in a field of study related to the petroleum industry.

The fellowships, which may be renewed, are open to Canadian citizens or persons holding landed immigrant status one year prior to application who are graduates of Canadian universities or colleges which are members or affiliates of the Association of Universities and Colleges of Canada and are tenable only at universities in this category.

Application forms and further details may be obtained by writing to: The Director of Awards, Association of Universities and Colleges of Canada, 151 Slater Street, Ottawa, Ontario, K1P 5N1.

Applications must be submitted by the 1st of March.

Imperial Oil Graduate Research Fellowships

Imperial Oil Limited annually offers five fellowships, up to the value of $3,000 per year for a maximum of three academic years, for study and research leading to the Ph.D. degree in pure and applied sciences, the social sciences, or the humanities.

The fellowships are open to graduates of approved Canadian universities. Nomination forms and further details may be obtained from the Graduate Studies Office.

The student must be nominated for this award by the University before the end of January.

Shell Canada Fellowships in Engineering

Shell Canada offers fellowships, up to the value of $4,500 per year ($4,000 and $500 marriage allowance) for a maximum of three years for graduate study and research in Engineering at a Canadian university. The fellowships are payable in quarterly installments.

The specified fields of study are the following: Chemical Engineering, Civil Engineering, Electrical Engineering, Geological Engineering, Mechanical Engineering, Metallurgical Engineering, Mining Engineering, Petroleum Engineering, Engineering Physics.

The minimum prerequisite is a bachelor's degree in Engineering. Applicants must have completed at least one year of graduate study and research in one of the specified fields of Engineering and must indicate an intention to undertake a Ph.D. program in Canada. Preference will be given to Canadian citizens.

Application should be made to: The Selection Committee Shell Canada Fellowships in Engineering, c/o National Research Council, Ottawa, Ontario, no later than January 15.

Shell Canada Fellowship in Geology

Shell Canada provides annually a post-graduate fellowship, valued at $1,500 ($1,200 payable to the Fellow, and $300 to the University) for graduate study and research.

The fellowship, which may be renewed, is open to students admitted to or enrolled in a Ph.D. program in the Department of Geology. Application is not required. The recipient is chosen by the Awards Committee following nomination by the Department of Geology.

Consolidated Mining and Smelting Graduate Research Fellowships

The Consolidated Mining and Smelting Company of Trail, B.C. annually offers ten graduate research fellowships valued at $2,200 which are tenable at Canadian universities. Awards will be made for full-time graduate research in the fields of mining, geology, metallurgy, chemistry, chemical engineering, physics, agriculture, electrical engineering, mechanical engineering, or civil engineering.

Candidates must be Canadian citizens and graduates in pure science, applied science, or agriculture from recognized universities. Each application must be supported by a letter of approval from an appropriate authority of the university at which the research is to be undertaken. Applications should be sent to C.M.S.C.

I.O.D.E. War Memorial Scholarships

Several annual scholarships valued at $3,000 are offered by The Imperial Order Daughters of the Empire for post-graduate study and research in the Humanities or Social Sciences at Canadian universities.

The *First War Memorial Scholarship* is awarded for study in the Social Sciences and the *Second War Memorial Scholarships* for study in the Humanities. In each case candidates must be Canadian citizens and graduates of recognized colleges or universities.

Additional information and application forms may be obtained by writing to the I.O.D.E. Educational Secretary for the Province of Ontario, 168 Jackson Street West, Hamilton, Ontario. The closing date for receipt of completed applications is the 15th of November.

J. H. Stewart Reid Memorial Fellowship

An award of $2,500 in the graduate program of any Canadian university is offered for one year only. The field of study is unrestricted. The qualifications are Canadian citizenship or residence in Canada with landed immigrant status from February 1, 1972 or earlier, and graduate student standing or admission to a Canadian graduate program by time of award. Applications must be submitted by April 15, 1973.

Application forms and further information may be obtained from: The Awards Officer, Canadian Association of University Teachers, 66 Lisgar Street, Ottawa, Ontario, K2P 0C1.

Resources for the Future Incorporated

The RFF Inc. offers annual doctoral dissertation fellowships of $4,000 in Natural Resources to assist qualified graduate students in completing doctoral dissertation work and to stimulate their interest in the application of social science disciplines to problems in the field of natural resources. Candidates must be nominated by the academic department in which the student is a doctoral candidate. Direct applications are not accepted.

Nominees must have completed all requirements for the doctorate except the dissertation before the start of the 1973-74 academic year. Research must relate to natural resources, their products or services, and must involve the social sciences or related fields of study. Nominations must be received by February 1, 1973. Consult the Graduate Studies Office for further details or

write Resources for the Future, Inc., Fellowship Program, 1755 Massachusetts Ave. N.W., Washington, D.C. 20036.

Canadian Advertising Advisory Board

Doctoral fellowships up to $4,000 are available for any approved research project in the economic and social aspects of advertising. These fellowships are open to any Canadian citizen or anyone residing in Canada working towards a doctoral degree. Candidates are expected to be at or near the dissertation stage. Applications, to be made before March 31, 1973, should be made directly to: Director of Awards, Canadian Advertising Advisory Board, 159 Bay Street, Toronto 116, Ontario.

Canadian Emergency Measures Organization Research Fellowship

The amount of $4,500 is awarded annually in the field of study of human behavior under stress, with preference given to Canadian residents who hold a Master's degree in Sociology or other suitable discipline. Closing date for application is March 1, 1973. For further information and application forms, write to: Director of Awards, The Association of Universities and Colleges of Canada, 151 Slater Street, Ottawa, Ontario, K1P 5N1.

Canadian Department of Labour — University Research Program

Grants ranging up to $5,000 a year are provided for research studies in the field of labour relations and labour economics. Applications are accepted from graduate students and university faculty members, provided they are Canadian citizens or can demonstrate they will be residing in Canada on a continuing basis. For further information and application forms, write to The Secretary, Department of Labour — University Research Committee, Economics and Research Branch, Canada Department of Labour, Ottawa, Ontario, K1A 0J2. Applications must be received by February 15, 1973.

GRANTS AND LOANS

Ontario Student Awards Program

All students who are residents of Ontario and who satisfy the admission requirements of a Canadian university or an eligible post-secondary institution in Ontario may apply for an award under this program.

To receive an award a student must establish a need for assistance and enroll in an eligible institution in the year of the award. An award under this program will be made to the extent of established need in a combination of a non-repayable grant and a Canada Student Loan. Application forms are available from the Awards Office at Carleton. Deadline date for applications is July 1st for replies prior to fall registration.

Canada Student Loans Plan

Students who do not qualify for financial assistance under the Ontario Student Awards Program may apply for a Canada Student Loan.

Application forms and a brochure containing details of the plan, including conditions of eligibility, may be obtained from the Awards Office at Carleton University.

DEPARTMENTAL PROGRAM DESCRIPTIONS
AND DETAILS OF COURSES

ARTS — Humanities

Art History
Classics
Comparative Literature
English Language and Literature
French
German
History
Philosophy
Spanish

ARTS — Social Sciences

Canadian Studies*
Economics
Geography
International Affairs
Law
Political Science
Psychology
Public Administration
Social Work
Sociology
Soviet and East European Studies

*The interdisciplinary program in Canadian Studies includes course selections from both the Humanities and the Social Sciences.

ART HISTORY

Chairman of the Department: Eric E. Hirshler

The Department of Art History offers two courses at the graduate level, under the aegis of the Institute of Canadian Studies.

GRADUATE COURSES

Art History 11.505 Selected Aspects of Canadian Art History

A seminar, which will study specific areas of the whole field of Canadian art, such as of New France; the early architecture of Canada; the painters and topographical artists of the English colonial period; the arts of the Confederation period; and the arts of the later 19th and of the 20th centuries.

Prerequisite: Honours courses in Art History or the equivalent or permission of the instructor.

Seminar three hours a week, fall and winter terms.

M.-L. Funke, D. Goodreau and members of the Curatorial Staff, National Gallery.

Art History 11.506, 507, 508 Directed Reading and Research

*506 fall term, 507 winter term, 508 spring term.

Tutorials designed to permit advanced students to pursue topics in Canadian art which they have selected in consultation with the staff.

Prerequisite: Permission of the instructor and the Institute of Canadian Studies.

Seminar two hours a week.

M.-L. Funke, D. Goodreau, and members of the Curatorial Staff, National Gallery.

CLASSICS

Chairman of the Department: T. R. Robinson

The Department of Classics offers programs of study leading to the degree of Master of Arts. The following three program categories are available:

- Classics.
- Greek only.
- Latin only.

QUALIFYING YEAR

Applicants who hold a general (pass) B.A. degree will normally be required to complete successfully a Qualifying Year program before proceeding to the Master's program. Refer to the general section of this Calendar for the regulations governing a Qualifying Year.

Program Requirements

The Qualifying Year program will correspond quite closely to the final year of the Honours undergraduate program in Classics and will normally include at least two graduate or senior undergraduate courses in literature.

MASTER OF ARTS

Admission Requirements

The minimum requirement for admission to the Master's program is an Honours B.A. degree in Classics, Latin, or Greek.

The Department also specifies the following two prerequisites:

- All students must demonstrate a knowledge of German. Credit in German 22.015, or an approved equivalent, will be accepted.
- Students taking the degree in Greek only must have credit in Senior Matriculation Latin or an approved equivalent; those in Latin only must have credit in Greek 15.015 or an approved equivalent.

Program Requirements

The regulations governing program requirements are outlined in the general section of this Calendar. It should be noted that the Department of Classics does not offer the M.A. degree by course work alone.

Master's students will normally be required to complete three full-courses (or the equivalent) at the 500 level, and a thesis equivalent to two full-courses.

GRADUATE COURSES

Classics 14.505 Introduction to Linguistics
Seminar two hours a week, fall term.
Members of the Department

Classics 14.506 Elementary Textual Criticism
Seminar two hours a week, winter term.
Members of the Department

Classics 14.520 A Greek Author
Seminar two hours a week, fall and winter terms.
Members of the Department

Classics 14.521 A Latin Author
Seminar two hours a week, fall and winter terms.
Members of the Department

Classics 14.530 A Greek Literary Period or Genre
Seminar two hours a week, fall and winter terms.
Members of the Department

Classics 14.531 A Latin Literary Genre
Seminar two hours a week, fall and winter terms.
Members of the Department

Classics 14.540 Greek Literary Critics and Theorists

Classics 14.599 M.A. Thesis

COMPARATIVE LITERATURE

Chairman of the Committee: Hans-George Ruprecht

The Comparative Literature Committee offers programs of graduate study leading to the degree of Master of Arts.

The purpose of the Comparative Literature program is to study literature in its international context, and to relate and compare literary phenomena usually studied in isolation because of linguistic barriers and the traditional departmental division of academic disciplines. Thus, taking into account the interrelation of all humanistic studies such as the various literatures, philosophy, psychology, sociology, the visual arts and history, "comparatists" view literary creation within the total complex evolution of world literature. The historical flow of literary archetypes, the role of folklore and myth in literature, recurrent problems of literary theory, consideration of the less well known literatures of the world, are some of the objects of Comparative Literature studies.

The study of this discipline must be based on a truly comparative perspective, on a solid linguistic foundation and on an awareness of all the difficulties that arise in Comparative Literature conceived as a domain both within and beyond limits of national literatures.

Students registered in other language departments, who wish to enroll in one or more courses from the Comparative Literature program, must demonstrate a reading knowledge of the languages required for each course. Three years of study at the university level will normally constitute the required level of language proficiency.

QUALIFYING YEAR PROGRAM

Applicants who hold only a general (pass) B.A. degree will normally be required to complete successfully the four qualifying half-courses listed below while pursuing their special interests in the field. The total course programme is to be worked out in consultation with the Graduate Student Supervisor. Formal admission to the Master's programme may be considered at the end of the first term.

The four qualifying half-courses are:

Comparative Literature: **17.401** Literary Studies and Linguistics
17.402 Literary Studies and Aesthetics
17.403 Literary Studies and History
17.404 Literary Studies and Sociology

MASTER OF ARTS

Admission Requirements

The regulations governing admission to the Master's program are outlined in the general section of this Calendar.

The specific requirements for admission to the Master's program in Comparative Literature are the following:

- An Honours B.A. degree (or the equivalent) with at least second class standing, including two full literature courses at the senior undergraduate level in each of the two language fields (studied in the original language). Candidates who hold degrees in only one national literature will be required to take additional courses or to enrol in the Qualifying Year program.
- In addition to proficiency in English, students must have a comprehensive knowledge of either French or German (including the ability to read primary and secondary sources in that language and to participate occasionally in class discussion in that language).
- A reading knowledge of at least one additional language from among the following: French, German, Spanish, Italian, Russian, Latin or classical Greek. In special cases the Committee may permit the substitution of some other language. Three years of study at the university level will normally constitute the required level of language proficiency. The Committee reserves the right to test proficiency and reading knowledge by examination.

Program Requirements

The program requirements for Master's candidates in Comparative Literature are the following:

- Comparative Literature 17.501 Theory of Literature and Standard Problems in Comparative Literature.
- The four basic half-courses listed above in the Qualifying Year program. Students who have already taken one or more of these courses, (or the equivalent) will substitute other appropriate Comparative Literature courses.
- One of the following:
    Comparative Literature 17.599 M.A. Thesis.
    Two additional courses in Comparative Literature.
- A final comprehensive examination (written or oral).

In all cases the Committee will prescribe a program of studies that will complement the student's background and special interest.

GRADUATE COURSES

Prerequisite for all graduate level courses: appropriate linguistic ability and approval of the Comparative Literature Committee.

Comparative Literature 17.501 Theory of Literature and Standard Problems in Comparative Literature

An examination at an advanced level of the question "what is literature?" in the light of major contributions to the theory of literature (Russian formalism, Ingarden, New Critics, Sartre, Marxist approach to literature; nouvelle critique); followed by a presentation of problems of Comparative

Literature such as the interaction of national literatures, international literary currents, and generic aspects of literature seen from a world perspective. The language prerequisites are those of the Comparative Literature Program as a whole. Essays may be written either in English, German, French or Spanish.

Prerequisite: Comparative Literature 17.401, 17.402, 17.403, 17.404 or permission of the instructor.

Seminar three hours a week, fall and winter terms.

H.-G. Ruprecht

Comparative Literature 17.506 Styles and Periods

Topic: The Modern Long Poem.

This course will explore the structural and thematic characteristics of the Modern Long Poem since Whitman and the way it achieves, or interestingly fails to achieve, unity or mythical significance. Poems to be discussed will include Williams' *Paterson,* Hart Crane's *The Bridge,* Berryman's *Homage to Mistress Bradstreet,* Eliot's *The Four Quartets,* St. John Perse's *Anabasis,* Rilke's *Duineser Elegien* and Lorca's *Poeta en Nueva York.*

Prerequisites: Permission of the instructor and fluent French, German or Spanish.

Seminar three hours a week, fall and winter terms.

C. Levenson

Comparative Literature 17.507 Study of a Theme or Motif

Topic: The Resurgence of Ancient Myths in Modern Poetry.

Comparative studies on the recurrence and permutation of mythical and literary subject matter such as Hercules and the Centaurs, the Fauns, Salome, Cleopatra, Ophelia, the Androgyne, the Sphinx, Pan, in French, Spanish, German and English lyric poetry of the 'fin de siècle' and early 20th century.

Prerequisites: Reading knowledge of either French, Spanish or German and permission of the instructor. Essays may be written either in English or any of the above-mentioned languages.

Seminar three hours a week, winter term.

H.-G. Ruprecht

Comparative Literature 17.510 Special Topics in Modern Fiction

Topic: The Evolution of Subjectivity in the Modern Novel.

An analysis of Modern European, American and Canadian novels from the point of view of Lukács' concept of the problematic hero including the phenomenon of the dissolution of character.

Prerequisites: Reading knowledge of at least one of the following languages: French, Italian, German, Russian, Polish, Spanish and permission of the instructor.

Seminar three hours a week, fall and winter terms.

W. Krysinski

Comparative Literature 17.530 Literary Archetypes

Topic: The survival of classical myths in Modern Drama.

An examination of the recurrent dramatic possibilities of certain mythical figures and of their stories: Orpheus, Prometheus, Antigone, Electra, Oedipus, etc. : . . Theories of myth will be explored with a view to understanding the transition between myth and literature; and more particularly the use of mythical elements in dramatic structure. As cultural distance increases the dramatist must delve more deeply into archetypal meanings to be able to depict characters and conflicts as meaningful to modern man as were the myths to the Greeks and Romans.

Prerequisite: Reading knowledge of French or German; the use of other modern languages, and Greek and Latin, may be discussed with the instructor.

Seminar three hours a week, fall term.

E. Kushner

Comparative Literature 17.561 Studies in Literary Genres

Topic: The Picaresque Novel.

The Picaresque Novel from the *Lazarillo* to *Moll Flanders*: A Look at Recent Interpretations.

Prerequisites: Reading knowledge of Spanish or French and permission of the instructor.

Seminar three hours a week, fall and winter terms.

C. Marsden

Comparative Literature 17.590 Seminar in Comparative Literature

Topic: The Evolution of the Concept of Love-Sickness in Medieval and Early Renaissance Literature.

The purpose of this course is to study the correlation between medical doctrines and literary conventions (style and thematics) from the Greeks to the early Renaissance. Emphasis will be placed on the concept of aegritudo-amoris, as relevant to erotic poetry both in Classical times and in the Middle Ages. Students will be requested to read selected passages from philosophical, medical and literary texts. The main literary examples in this course will be taken from 12th century French and 13th century Italian poetry.

Prerequisite: Reading knowledge of Italian or French.

Seminar three hours a week, fall and winter terms.

M. Ciavolella

Comparative Literature 17.591 Seminar in Comparative Literature

Topic: To be announced later.

Seminar five hours a week, summer session, evening.

Instructor to be announced.

Comparative Literature 17.592 Seminar in Comparative Literature

Topic: From Chekhov to the Theatre of the Absurd.

An examination of Chekhov's dramatic theory and technique as compared to the theatre of Beckett and the plays of Pinter.

Prerequisite: No language requirements and permission of the instructor.

Seminar three hours a week, fall and winter terms.

A. Tarn

Comparative Literature 17.599 M.A. Thesis

ENGLISH LANGUAGE AND LITERATURE

Chairman of the Department: James Downey
Supervisor of Graduate Studies: R. H. MacDonald

The Department of English offers programs of study leading to the M.A. degree in English Language and Literature. Additional information may be obtained by consulting the Department's Supervisor of Graduate Studies.

QUALIFYING YEAR PROGRAM

Applicants who hold a general (pass) B.A. degree with at least B– standing, with a major in English Language and Literature, may be admitted to the Qualifying Year Program. Normally, these students will be required to complete four or five full-courses (or the equivalent) in English as determined by the Department and to maintain at least a B– average in the Qualifying Year courses, before being considered for admission into the Master's program.

MASTER OF ARTS

Admission Requirements

The minimum admission requirement for the Master's program is an Honours B.A. (or the equivalent) in English Language and Literature, with at least a B– average and including at least FIVE of the following areas:

History of the English Language OR General English Linguistics.
Old English OR Middle English.
Renaissance Literature.
Drama (including Shakespeare).
Restoration and Eighteenth-Century Literature.
Romantic and Nineteenth-Century Literature.
Twentieth-Century Literature.
Canadian Literature.

Possession of the minimum entrance standing is not in itself, however, an assurance of admission into the program.

Program Requirements

Each candidate will select ONE of the following optional program patterns:

- Three full-courses (or the equivalent) in English, including English 18.598 (Directed Special Studies), selected from those offered at the 500 level, and a Master's thesis. An oral examination on the thesis and related fields will also be undertaken.
- Five full-courses (or the equivalent) in English, including English 18.598 (Directed Special Studies), selected from those offered at the 500 level.

Under certain conditions, ONE of the optional courses in either program pattern may be selected from those offered by the Department of English at the senior undergraduate level in a field for which no graduate course is available. One of the optional courses may also be a cognate course at the graduate or the senior undergraduate level offered by another department. However, not more than one undergraduate course may be included in the total program.

All candidates are required to demonstrate a reading knowledge of one language other than English approved by the Department.

Academic Standing

A standing of B– or better must be obtained in each course counted towards the Master's degree.

Financial Assistance

A limited number of graduate teaching fellowships are available for adequately qualified M.A. candidates. Refer to the Awards section of this Calendar for further information on these and other forms of assistance.

GRADUATE COURSES

English 18.500 Literary Criticism
A study of specific topics or particular areas of literary criticism.
Seminar two hours a week, fall and winter terms.
A. Tilson

English 18.521 Middle English Poetry
In 1973-74 a study of the works of the *Gawain*-poet, including *Sir Gawain and the Green Knight, Pearl, Patience, Purity,* and *St. Erkenwald.*
Seminar two hours a week, fall term.
E. Padolsky

English 18.527 Chaucer
A study of *The Canterbury Tales,* together with contemporary background and current critical writings.
Seminar two hours a week, fall term.
Not offered 1973-74

English 18.528 Middle English Studies
A study of the English language and literature between the Norman Conquest and the fifteenth century. In 1973-74, the seminar will investigate the nature of Malory's *Morte Darthur.*
Seminar two hours a week, winter term.
Maureen Gunn

English 18.531 Milton
A comprehensive study of Milton's works.
Seminar two hours a week, fall and winter terms.
Not offered 1973-74

English 18.532 Seventeenth-Century Studies
In 1973-74 a study of the major poets, especially Donne, Jonson, and their successors.
Seminar two hours a week, fall and winter terms.
L. Mann

English 18.536 Shakespeare
A study of selected works of Shakespeare and his literary background.
Seminar two hours a week, fall and winter terms.
P. Cruttwell

English 18.537 Spenser
A study of *The Faerie Queene,* together with contemporary background and current critical writings.
Seminar two hours a week, winter term.
Not offered 1973-74

English 18.538 Renaissance Studies
A study of particular problems of Renaissance literature and thought.
Seminar two hours a week, fall and winter terms.
Not offered 1973-74

English 18.548 Studies in Romanticism
Seminar two hours a week, fall and winter terms.
Not offered 1973-74

English 18.551 Major Victorian Poets
A detailed study of the poetry of Tennyson, Browning, and Arnold, with some emphasis on their longer works.
Seminar two hours a week, fall and winter terms.
Not offered 1973-74

English 18.553 The Nineteenth-Century Novel
A study of a select group of novels of the period.
Seminar two hours a week, fall and winter terms.
T. J. Middlebro'

English 18.561 Twentieth-Century Poetry
In 1973-74 a study of the poetry of W. B. Yeats.
Seminar two hours a week, fall term.
Mariana Ryan

English 18.563 The Modern Novel

The course will concentrate on the principal developments in the art of fiction since 1900.

Seminar two hours a week, fall and winter terms.

Not offered 1973-74

English 18.564 Modern Drama

A survey of major dramatists and the themes and theatrical traditions which they represent. In 1973-74, a study of contemporary British drama.

Seminar two hours a week, fall and winter terms.

A. Tarn

English 18.566 Henry James

The art of fiction as exemplified in James's theory and practice. Major writings from all phases of his career will be considered.

Seminar two hours a week, fall term.

A. M. Beattie

English 18.567 Studies in Modern Fiction Writers

In 1973-74 a study of experiments in fiction in the twentieth century.

Seminar two hours a week, winter term.

A. M. Beattie

English 18.568 Twentieth-Century Studies

In 1973-74 the topic will be irony in modern fiction, with particular emphasis on the work of Crane and Waugh.

Seminar two hours a week, fall and winter terms.

M. LaFrance

English 18.571 Studies in American Poetry

An intensive study of the poetry and aesthetic theories of Poe, Emerson, and Whitman with emphasis on particular problems of American Romanticism.

Seminar two hours a week, fall and winter terms.

V. K. Chari

English 18.578 Studies in American Fiction

Selected studies concerning the American novel and short story, concentrating on the period 1890 to the present.

Seminar two hours a week, fall and winter terms.

Not offered 1973-74

English 18.581 Studies in Canadian Poetry

In 1973-74 a study of the Montreal movement (1940's to 1960's) with particular reference to Dudek, Layton and Souster.
Seminar two hours a week, fall and winter terms.
M. M. Gnarowski

In spring term, the topic will be the theme of modernism in Canadian poetry.
Seminar five hours a week, summer session, evening division, 1973.
M. M. Gnarowski

English 18.583 Studies in Canadian Fiction

A seminar organized so that some major themes in, and concepts about, Canadian fiction will be studied in detail.
Seminar two hours a week, fall and winter terms.
Mary Jane Edwards

English 18.587 Studies in Canadian Literature

A comparative dimension: concepts and values in the evolution of the literatures of Canada and the United States. Selected texts.
Seminar two hours a week, fall and winter terms.
R. L. McDougall

English 18.590 Selected Topic

A seminar on a specialized area of literary studies, a particular author, idea, theme, myth, or form. In 1973-74 the topic will be "Satire and Sentiment": a close reading of Swift and Sterne.
Seminar two hours a week, fall and winter terms.
J. Downey

In spring term, the topic will be "The Limits of Irony": a study of Swift, Pope, Johnson, Fielding and Austen.
Seminar five hours a week, summer session, evening division, 1973.
R. B. Lovejoy

English 18.594 Special Studies in Dramatic Literature

In 1973-74 a study of Anglo-Irish drama, with special emphasis on the plays of Lady Gregory, W. B. Yeats, and J. M. Synge.
Seminar two hours a week, winter term.
Lorna Young

English 18.598 Directed Special Studies

Required course for all M.A. students. Those enrolled in the all-course program will be assigned to an adviser who will direct their area of special studies. Those enrolled in the thesis program will meet with their thesis supervisors for special tutorials connected with their field of research.
Tutorials, fall and winter terms.
Members of the Department

English 18.599 M.A. Thesis
Members of the Department

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FRENCH

Chairman of the Department: P. Clive
Supervisor of Graduate Studies: E. Kaye

The Department of French offers a program of studies leading to the degree of Master of Arts in French language and literature.

QUALIFYING YEAR PROGRAM

Applicants who hold a general (pass) bachelor's degree with second class standing or higher, with a major in French, will be required to register in the Qualifying Year program (normally five courses in French chosen from those numbered at the 400 level), and maintain at least B– standing in each of these courses, before proceeding to the M.A. program.

MASTER OF ARTS

Admission Requirements

The normal requirement for admission into the Master's program is an Honours B.A. in French with second class standing.

Program Requirements

Master's candidates are normally required to enrol in five full courses (or the equivalent), of which at least three must be chosen from those numbered at the 500 level.

All Master's students must undertake a comprehensive examination (written and oral). The written part will consist of questions based on a reading list of approximately six texts, and the oral section will consist of a series of general questions. The syllabus for this examination will be distributed in December, and it will be undertaken in either May or September.

With the approval of the Department, Master's students in French may select a Comparative Literature Course in partial fulfilment of their program requirements.

Academic Standing

A grade of at least B– must be obtained in each course counted for credit towards the Master's degree.

SELECTION OF COURSES

The following senior undergraduate courses are open to students in the Qualifying Year program and, with the approval of the Department, to students in the M.A. program:

French 20.401   Stylistique littéraire, analyse des procédés d'écriture, travaux pratiques

20.430   Formes, mythes et réalité sociale dans le miroir de la critique contemporaine

20.440   La dissolution du héros dans le roman contemporain

20.460	Les grands auteurs dramatiques du XVIIe siècle: Corneille, Molière, Racine
20.465	La littérature canadienne-française: Le nationalisme dans ses manifestations littéraires, d'Arthur Buies aux auteurs modernes
20.470	Le roman au XVIIIe siècle
	(Fall and winter terms)
	La pensée morale au XVIIe siècle: Pascal, Bossuet, La Rochefoucauld, La Bruyère, etc.
	(Summer session 1973, Evening division.)

GRADUATE COURSES

The graduate courses offered by the Department are open to students in the M.A. program and, with permission of the Department, to students in the Qualifying Year program. For prerequisites, please consult the Department.

French 20.501 Aspects de la linguistique
Linguistique et littérature. Les modèles linguistiques de description, analyse et codage de textes. Ordinateur et études littéraires.
Lectures two hours a week, fall and winter terms.
P. Laurette

French 20.520 Aspects de la littérature canadienne-française
La thematique de la poésie québécoise depuis 1960.
Lectures two hours a week, fall and winter terms.
G. Robert

French 20.525 Aspects de la littérature médiévale
La version commune de la légende de Tristan et Iseut dans le poème de Béroul et la *Folie Tristan* de Berne.
Lectures two hours a week, fall and winter terms.
J. Miquet

French 20.530 Aspects de la littérature de la Renaissance
Montaigne.
Lectures two hours a week, fall and winter terms.
E. Kushner

French 20.535 Aspects de la littérature du XVIIe siècle
Lectures two hours a week, fall and winter terms.
Not offered 1973-74

French 20.540 Aspects de la littérature du XVIIIe siècle
Lectures two hours a week, fall and winter terms.
Not offered 1973-74

French 20.545 Aspects de la littérature du XIXe siècle
Lectures two hours a week, fall and winter terms.
Not offered 1973-74

French 20.550 Aspects de la littérature du XXe siècle
Jean-Paul Sartre et les chemins de l'humanisme tragique. Fiction, théâtre et prose d'idées.
Lectures two hours a week, fall and winter terms.
E. Zimmerman

Principaux courants de la poésie moderne: Apollinaire, Valéry, Breton, Supervielle, etc.
Summer session 1973, Day division.
R. Couffignal

French 20.570 Seminar on a Particular Author
Seminar two hours a week, fall and winter terms.
Not offered 1973-74

French 20.585 Seminar on a Problem of Literary History
Tragique et fantastique dans Baudelaire (*Fleurs du Mal, Poèmes en prose*).
Seminar two hours a week, fall and winter terms.
C. Hérisson

French 20.590 Etudes dirigées
Tutorials, fall and winter terms.
Members of the Department

French 20.599 M.A. Thesis

GERMAN

Chairman of the Department: Robert Gould
Supervisor of Graduate Studies: Jutta Goheen

The Department of German offers programs of study leading to the degree of Master of Arts. These include courses on all major periods in German literature, genres, themes and a number of individual authors, as well as on aspects of literary theory and the study of the German language. The Age of Goethe figures prominently in the teaching and research of three faculty members, and the Department offers a particularly favourable setting for specialized studies in this period.

Departmental requirements conform to those outlined for Master's students in the general regulations section of this Calendar. Further information concerning graduate work in German can be obtained from the Department.

Program Requirements

Masters' students in German will normally be required to select and follow one of the following optional program patterns:

- Three full-courses (or the equivalent) and a thesis.
- Five full-courses, or the equivalent.

All Master's students are also required to undertake a comprehensive examination, based on a departmental reading list.

SELECTION OF COURSES

The following senior undergraduate courses are open, with the approval of the Department, to students in the M.A. program. Students in the Qualifying Year program may take additional undergraduate courses.

German	22.412	History of the German Language
	22.430	Medieval Language and Literature
	22.451	Goethe (I)
	22.452	Goethe (II)
	22.460	German Romanticism
	22.470	Seminar on a Literary or Linguistic Topic
	22.471	Seminar on a Selected Topic
	22.490	Tutorial
	22.491	Tutorial

GRADUATE COURSES

Course numbers (except 22.599) refer to the area of study, to the term in which the course is offered, and to its designation as a half-course (half-credit). For example, a topic in *Literary Theory* may be offered as a half-course in either the fall term (530) or the winter term (531), or as a full-course spanning both terms (530 *and* 531).

German 22.530, 531 Literary Theory

531 Poetry and science: The connections of Goethe's scientific activities and theories with his writing. Imaginative literature and autobiographical texts will be discussed with particular reference to his theories of growth and development.

Seminar three hours a week, winter term.

Robert Gould

German 22.540, 541 Genres in German Literature

540 Struktur des modernen Romans. Erzählerfigur und Zeitbegriff als Strukturelemente der Erzählkunst in Thomas Mann's *Doktor Faustus,* Franz Kafka's *Das Schloss,* Günter Grass' *Hundejahre.*

Seminar three hours a week, fall term.

Jutta Goheen

541 The German idyll from Gessner to Mörike. An exploration of that chameleon of genres, the idyll, during its greatest century in Germany, with some attention to classical prototypes and the theory of the idyll from Fontenelle to Schiller. A close reading of works by Gessner, Maler Müller, Voss, Kosegarten, Goethe, Hebel, Jean Paul, Usteri, and Mörike.

Seminar three hours a week, winter term.

Joseph B. Dallett

German 22.550, 551 Prevalent Themes in German Literature

550 Myth in drama. This topic will be explored with reference to texts by Fouqué, Hofmannsthal, Hauptmann, Richard Wagner, and especially the latter's theoretical writings.

Seminar three hours a week, fall term.

E. M. Oppenheimer

German 22.560, 561 Period Studies

560 Madness and hallucination in German Romanticism. The role of mental abnormality at different stages of the romantic movement.
Seminar three hours a week, fall term.

Robert Gould

Not offered 1973-74

561 Dichter und Tradition in mittelalterlicher Lyrik. Walther von der Vogelweides Minnesang, politische und religiöse Dichtung im Zeichen der literarischen Konventionen des Mittelalters.

Three hours a week, winter term.

Jutta Goheen

German 22.570, 571 Individual Authors

570 Schillers Dramen I. Textinterpretation mit verschiedenen Methoden; Zeit- und Persönlichkeitsbezüge.

Seminar three hours a week, fall term.

Katharina Mommsen

571 Schillers Dramen II. Textinterpretation mit verschiedenen Methoden; Zeit- und Persönlichkeitsbezüge.

Seminar three hours a week, winter term.

Katharina Mommsen

German 22.580, 581 Linguistic Problems

580 German grammar for language teachers. "Traditional" and "modern" theories of the German language as a basis for descriptive analysis of selected linguistic features (particularly in the field of syntax) and their contribution to understanding problems of learning German as a foreign language.

Seminar three hours a week, fall term.

Jutta Goheen

Not offered 1973-74

581 Applied linguistics: pedagogic grammar of German. Theoretical foundations of language teaching (syntax and semantics) as reflected in textbooks and in various methods of instruction, e.g. contrastive approach, direct method, translation.

Prerequisite: German 22.580 or permission of the instructor.
Seminar three hours a week, winter term.

Jutta Goheen

Not offered 1973-74

German 22.590, 591 Special Topic

Tutorials, fall or winter term.

Members of the Department

German 22.599 M.A. Thesis

HISTORY

Chairman of the Department: P. J. King
Supervisor of Graduate Studies: B. C. Bickerton

The Department of History offers studies leading to the degree of Master of Arts and will introduce in the fall term, 1973, programs of study and research leading to the degree of Doctor of Philosophy.

MASTER OF ARTS

Admission Requirements

The minimum requirement for admission to the Master's program is an Honours bachelor's degree (or the equivalent) with at least second-class standing.

The Department offers no Qualifying Year program; applicants with a general (pass) degree may be considered for admission into the fourth year of Carleton's Honours B.A. program.

The Department offers the M.A. in fields for which there are adequate resources in Ottawa. Candidates in fields other than Canadian history are expected to write a thesis, to follow a program of directed studies in an appropriate field and to write a comprehensive examination.

Program Requirements

The specific program requirements in Canadian History are the following:

- **History 24.588** Historiography of North America.
- **History 24.590** Preparation for a written M.A. field examination (two full course credits).
- One of:
    History 24.599 Thesis and seminar participation.
    Two additional graduate seminars, one of which may be an approved seminar in a related field.

All candidates are also required to demonstrate a reading knowledge of a language other than English, the choice to depend upon the field of the candidate's thesis or research.

DOCTOR OF PHILOSOPHY

Admission Requirements

Applicants with an M.A. degree will be expected to have at least high second-class standing. Applicants with an Honours B.A. with first-class standing may be admitted directly into the Ph.D. program.

Residence Requirements

A minimum of three years of full-time study after the B.A. Honours degree or two years after the M.A.

Program Requirements

Candidates will be responsible for three fields, one of which will be related to the subject of thesis research and one of which may be in a related discipline. The fields will normally be selected from Canadian history, American history, modern British history and an aspect of modern European history. Each field will cover approximately one century.

There will be one oral examination covering the three fields. This examination will not be taken before the end of the first year and not later than the end of the second year.

A reading knowledge of French will be required. The language examination will be written early in the first year and before the candidate is permitted to take the doctoral fields examination.

Students entering the program with an Honours B.A. will normally take **History 24.588:** Historiography of North America; **History 24.591:** Tutorial in a major field; **History 24.592:** Tutorial in a selected field; and two other graduate seminars in their first year.

Students entering the program with an M.A., and students entering the program with an Honours B.A. and who have completed the first year requirements, will be required to take three graduate seminars, one of which must be **History 24.688:** Social History.

All candidates will be required to write a thesis on a topic related to Canadian history.

GRADUATE COURSES

History 24.530 Studies in the Social and Intellectual History of pre-Confederation Canada, 1760-1860
Seminar three hours a week, fall and winter terms.
S. F. Wise

History 24.531 The Social and Economic History of Lower Canada, 1784-1850
Seminar three hours a week, fall and winter terms.
F. Ouellet

History 24.534 Aspects of Canadian Nationalism, 1867-1918
Seminar three hours a week, fall and winter terms.
R. T. Clippingdale
Not offered 1973-74

History 24.535 Canada's External Relations, 1891-1914
Seminar three hours a week, fall and winter terms.
D. M. L. Farr
Not offered 1973-74

History 24.536 Canada Between the Wars, 1919-1939
Seminar three hours a week, fall and winter terms, evening division.
H. B. Neatby

History 24.560 Late Imperial and Revolutionary Russia, 1855-1921
Seminar three hours a week, fall and winter terms.
R. C. Elwood

History 24.588 The Historiography of North America
A course, primarily for graduate students in History, in which the trends and methods of historical writing on North America will be examined.
Seminar three hours a week, fall and winter terms.
P. J. King and S. R. Mealing

History 24.590 Directed Study
Supervised study in a specified field, in preparation for a written M.A. examination (equivalent to two full-courses).
Tutorials fall and winter terms, or spring term.
Members of the Department

History 24.591 Tutorial in a Canadian Field
Tutorials in an area of Canadian history appropriate to the candidate's program.
Tutorials fall and winter terms.
Members of the Department

History 24.592 Directed Studies in a Related Field
Directed studies in a field other than Canadian history appropriate to the candidate's program.
Directed studies fall and winter terms.
Members of the Department

History 24.599 M.A. Thesis
A substantial historical investigation. The subject will be settled in consultation with the Department and a supervisor will be assigned. The candidate will be examined orally after presenting his thesis.
Members of the Department

History 24.688 Social History
A course, primarily for graduate students in history, in which the literature and methodology of basic aspects of social history will be examined.
Seminar three hours a week.
Members of the Department

PHILOSOPHY

Chairman of the Department: R. S. Talmage
Supervisor of Graduate Studies: B. Wand

The Department of Philosophy offers programs of study leading to the degree of Master of Arts.

QUALIFYING YEAR

Applicants who do not hold an Honours degree (or the equivalent) will be required to register in a Qualifying Year program before proceeding to the Master's program.

The regulations governing the Qualifying Year are outlined in the general section of this Calendar.

MASTER OF ARTS

Admission Requirements

Applicants for the Master's program must have an Honours degree (or the equivalent) in Philosophy, with at least second-class standing.

Program Requirements

The specific program requirements for Master's candidates are the following:

- Philosophy 32.545, the Departmental Seminar.
- A thesis equivalent to two full-course credits, which must be defended at an oral examination.
- Four half-course credits in at least three of the following study areas:
    Studies in the History of Philosophy.
    Studies in the Work of an Individual Philosopher
    Studies in Logic, Epistemology, or Metaphysics.
    Studies in Selected Problems in Philosophy.

In exceptional cases, a maximum of one full-course (or the equivalent) may be selected from those offered at the 400 level or in a related field or at another university.

Academic Standing

A grade of B– or better must be obtained in each course, on the thesis, and in the oral defence of the thesis.

SELECTION OF COURSES

The following senior undergraduate courses are open to students in the Qualifying Year and, with permission, to students in the M.A. program.

Philosophy 32.407 Hume
32.408 Kant
32.421 Epistemology

GRADUATE COURSES

The following graduate courses are open to students in the M.A. program and, with permission, to students in the Qualifying Year program. Five two-hour tutorial sessions will be required in each half-course.

Philosophy 32.504 Tutorial in the History of Philosophy I
Detailed study of a period or issue in the history of philosophy to be chosen in consultation with the Department.
Tutorials, fall term.
Members of the Department

Philosophy 32.505 Tutorial in the History of Philosophy II
Detailed study of a period or issue in the history of philosophy to be chosen in consultation with the Department.
Tutorials, winter term.
Members of the Department

Philosophy 32.514 Tutorial in the Work of an Individual Philosopher I
A critical and systematic study of the work of an individual philosopher to be chosen in consultation with the Department.
Tutorials, fall term.
Members of the Department

Philosophy 32.515 Tutorial in the Work of an Individual Philosopher II
A critical and systematic study of the work of an individual philosopher to be chosen in consultation with the Department.
Tutorials, winter term.
Members of the Department

Philosophy 32.524 Tutorial in Logic, Epistemology or Metaphysics I
An attempt to find a solution to a specific problem in logic, epistemology or metaphysics to be chosen in consultation with the Department.
Tutorials, fall term.
Members of the Department

Philosophy 32.525 Tutorial in Logic, Epistemology or Metaphysics II
An attempt to find a solution to a specific problem in logic, epistemology or metaphysics to be chosen in consultation with the Department.
Tutorials, winter term.
Members of the Department

Philosophy 32.534 Tutorial in Selected Problems of Philosophy I
An attempt to find a solution to a specific problem in some area, other than logic, epistemology or metaphysics, to be chosen in consultation with the Department.
Tutorials, fall term.
Members of the Department

Philosophy 32.535 Tutorial in Selected Problems of Philosophy II
An attempt to find a solution to a specific problem in some area, other than logic, epistemology or metaphysics, to be chosen in consultation with the Department.
Tutorials, winter term.
Members of the Department

Philosophy 32.545 Departmental Seminar
Research papers to be given by faculty members and students.
Seminar three hours a week, fall and winter terms.
R. S. Talmage

Philosophy 32.599 M.A. Thesis

SPANISH

Chairman of the Department: R. L. Jackson
Supervisor of Graduate Studies: F. Atienza

The Department of Spanish offers a Master's program with specialization in either Peninsular or Spanish American literature, or a combination of both.

All requests for more information concerning the program should be addressed to the Supervisor of Graduate Studies. The Department will supply reading lists for individual courses and for the general comprehensive examination, and a brochure containing details of particular requirements and other information related to Spanish studies at Carleton.

MASTER OF ARTS

Admission Requirements

The requirements for admission to the Master's program are outlined in the general regulations section of this Calendar.

Program Requirements

The minimum program requirements for Master's candidates are stated in the general regulations section.

The Master's program may be undertaken in one of the following three optional patterns:

- Three full-courses (or the equivalent), and a thesis equivalent to two full-courses.
- Four full-courses (or the equivalent), and a thesis equivalent to one full-course.
- Five full-courses (or the equivalent).

The Department of Spanish encourages candidates to select one of the thesis patterns.

The Department also requires all students to undertake General Comprehensive Examinations, and to complete a non-credit seminar on Bibliography and Research Methods.

Students wishing to study aspects of Hispanic literature not specifically offered by the Department may enrol in Spanish 38.590 (Directed Studies) if a specialist in the desired field is available.

All courses taken by graduate students shall be chosen in consultation with the Department. From time to time certain courses offered by other departments may be accepted as part of the Master's program in Spanish, and special arrangements can occasionally be made to undertake part of the program at universities in Spanish-speaking countries.

SELECTION OF COURSES

The following senior undergraduate courses are open to students in the Qualifying Year program and, with permission, to students in the M.A. program.

Spanish	**38.402**	Stylistics
	38.415	Introduction to Medieval Literature
	38.420	Cervantes
	38.430	Modern Spanish Novel
	38.435	Modern Spanish Theatre
	38.440	Modern Spanish Poetry
	38.450	Colonial Spanish American Literature
	38.460	20th Century Spanish American Novel
	38.470	20th Century Spanish American Poetry
	38.490	Seminar on a Special Topic
	38.491	Special Studies

GRADUATE COURSES

Spanish 38.505, 506 History of the Spanish Language

Texts and Basic Reference Texts: Lapesa, Rafael: *Historia de la lengua española*
Menéndez Pidal, R.: *Manual de gramática histórica española*
Fotitch, T.: *An Anthology of old Spanish*

Lectures three hours a week, 505 fall term, 506 winter term.

J. Jurado

Spanish 38.515, 516 Aspects of Medieval Literature

515 Not offered 1973-74

516 Study of the *Cantar de mio Cid*

A textual criticism of this Spanish masterpiece, dealing with its philological, literary and historical aspects.

Lectures three hours a week, winter term.

Basic Reference Texts: Cejador, J.: *El Cantar de mio Cid y la epopeya castellana* (*Rev. Hisp.,* XLIX, 1920, pp. 1-310).
Menéndez y Pelayo, M.: *Historia de la poesía castellana en la Edad Media.* Madrid. 1911-16, 4 *vols.* (see only *vol.* II).
Menéndez Pidal, R.: *Cantar de mio Cid. Texto, gramática y vocabulario.* Madrid. 1913, 3 *vols.*
Menéndez Pidal, R.: *La España del Cid.* Madrid. 1939, 4 *ed.*
Simón Díaz, J.: *Bibliografía de la literatura hispánica.* Madrid, 1949, *vol.* III.

J. Jurado
Not offered 1973-74

Spanish 38.520, 521 Special Topic on Golden Age Literature

The Picaresque Novel. An examination of the Spanish Picaresque novel with reference to the Picaresque in other literatures, in the light of recent interpretations.

Seminar three hours a week, 520 fall term, 521 winter term.

Basic Reference Texts: Parker, A. A.: *Literature and the Delinquent,* Edinburgh, 1957.

Guillén, C.: *Towards a Definition of the Picaresque,* ICLA. Proceedings of the Third Congress. The Hague, 1962, pp. 252-266.

(This course is cross-listed as Comparative Literature 17.561. Students enrolling in the latter will be more concerned with the European than the Spanish aspect.)

C. A. Marsden

Spanish 38.525, 526 Studies in 18th Century Neo-Classicism

525 Eighteenth Century Literature

Main authors and movements of the period with special emphasis on Luzán and Cadalso for prose; Meléndez Valdés for poetry; and L. Fernández de Moratín for theatre.

Lectures three hours a week, fall term.

Basic Reference Texts: Sarrailh, J.: *L'Espagne éclarée de la seconde moitié du XVIIIe siècle.* Paris. 1954.

Díaz-Plaja, G., Dirtor.: *Historia general de las literaturas hispánicas,* Barcelona, 1949, *vol.* IV.

Cotarelo y Mori, E.: *Iriarte y su época.* Madrid, 1897.

Simón Díaz, J.: *Manual de Bibliografía de la literatura española.* Madrid, 1956, pp. 1-55, 305-336.

Texts: *Biblioteca de autores españoles, desde la formación del lenguaje hasta nuestros días.* Madrid. 1846-80 and 1954 on.

J. Jurado

Not offered 1973-74

526 The Baroque Movement in the Eighteenth Century: Torres Villarroel and Porcel y Salablanca

A monographic study of the work of these two representative authors of the conceptism and culteranism movement in the Eighteenth Century.

Lectures three hours a week, winter term.

Basic Reference Texts: Hatzfeld, H.: *Estudios sobre el barroco.* Madrid, 1964.

Dámaso Alonso, M.: *Góngora y el "Polifemo"* . . . Madrid, 1961, 2 vols. 4 ed. (see only vol. I: "Estudio preliminar y antología gongorina")

Glendinning, N.: *La fortuna de Góngora en el s. XVIII* (*Rev. Fil. Esp.* XLIV, 1961, pp. 323-49).

Torres Villarroel and Porcel: see bibliography in *Historia general de las literaturas hispánicas,* vol. IV.

J. Jurado
Not offered 1973-74

Spanish 38.530, 531 Problems of Modern Spanish Literature
530 A. Machado: A Study of his Poetry and Poetics
Lectures three hours a week, fall term.
Basic Reference Texts: Zubiría, R.: *La poesía de A. Machado,* Madrid, 1955.
Cuadernos hispanoamericanos, 1949, (número dedicado a A. Machado).
de Albornoz, A.: *Unamuno y Machado.*
Sánchez Barbudo: *Estudio sobre Unamuno y Machado.*
Gullón, R.: *Una poética para A. Machado.*

F. Atienza
531 Not offered 1973-74

Spanish 38.550, 551 Aspects of Spanish American Literature before 1888
550 Baroque and esthetic traditions in Colonial Spanish America: A study of the works of Sor Juana Inés de la Cruz.
Seminar three hours a week, fall term.
Basic Reference Texts: Sor Juana Inés de la Cruz: *Obras completas,* F. Monterde ed. (México: Editorial Porrúa, 1969).

F. Hernández
Not offered 1973-74
551 Not offered 1973-74

Spanish 38.560, 561 Aspects of Spanish American Literature after 1888
The Spanish American Novel since 1947. Analysis and interpretation of works by Asturias, Carpentier, Rulfo, Vargas Llosa, Fuentes, Cortázar, García Márquez, and others.
Basic Reference Texts: Fuentes, C.: *La nueva novela hispanoamericana.*
Harss, L.: *Los nuestros [Into the Mainstream].*
Lafforgue, J. ed.: *Nueva novela latinoamericana.*
Ortega, J.: *La contemplación y la fiesta.*

R. Larson

Spanish 38.570, 571 Special Problems in Spanish American Literature
Topic for 1973-74: to be decided.

Spanish 38.590 Directed Studies
Tutorials, fall, winter, and spring terms.

Spanish 38.599 M.A. Thesis

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DEPARTMENTAL PROGRAM DESCRIPTIONS
AND DETAILS OF COURSES

ARTS - Social Sciences

Canadian Studies*
Economics
Geography
International Affairs
Law
Political Science
Psychology
Public Administration
Social Work
Sociology
Soviet and East European Studies

*The interdisciplinary program in Canadian Studies includes course selections from both the Humanities and the Social Sciences.

CANADIAN STUDIES

Director of the Institute: A. D. Dunton
General Editor, Carleton Library: Michael Gnarowski

The Institute of Canadian Studies offers programs of study and research leading to the degree of Master of Arts in Canadian Studies.

Through the medium of the Institute, the following departments co-operate in offering the programs:

Art History	Journalism
Economics	Law
English	Music
French	Political Science
Geography	Psychology
History	Sociology/Anthropology

The Canadian Studies program is interdisciplinary in emphasis but does enable the student to maintain a firm base in the discipline of his choice. Students are also encouraged to relate certain aspects of Canadian culture to corresponding aspects of the cultures of countries with which Canada has had traditional ties, notably Great Britain, France, the United States, and Australia.

The proximity of Carleton University to the National Library, the Library of Parliament, the Public Archives of Canada, the Dominion Bureau of Statistics, and the libraries of various government departments and embassies, ensures excellent research facilities for graduate candidates in Canadian Studies.

The Institute of Canadian Studies sponsors and gives editorial super-vision to the *Carleton Library,* a series of paperback reprints and compila-tions of classic material relating to Canadian history, law, economics, politics, anthropology, sociology, geography and journalism. There are 62 volumes to date.

A new series, *Carleton Contemporaries,* launched in 1968, consists of original monographs and compilations focussing on the issues of the day — political, social, economic, cultural. It is designed to stimulate informed discussion of current and controversial issues and to improve the two-way flow of ideas between people and governments.

The Institute also sponsors a variety of public lectures and seminars. The most prominent of these is the "Living Tradition" series, now available in five volumes.

Further information can be obtained by writing directly to the Institute.

QUALIFYING YEAR PROGRAM

Applicants with general (pass) bachelor's degree with high second-class standing, will be required to successfully complete a Qualifying Year of study before proceeding to the Master's program.

Refer to the general section of this Calendar for the regulations govern-ing the Qualifying Year.

MASTER OF ARTS

Admission Requirements

Applicants must normally hold an Honours B.A. (or the equivalent), with at least high second-class standing, in one of the disciplines represented in the Institute.

A reading knowledge of French is a prerequisite for admission.

Program Requirements

The minimum requirements for the Master's program are outlined in the general regulations section of this Calendar. The Institute of Canadian Studies specifies that all candidates must select one of the following program patterns:

- Three full-courses or the equivalent; thesis; and an oral comprehensive examination.
- Four full-courses or the equivalent; a research essay; and an oral comprehensive examination.

GRADUATE COURSES

Canadian Studies 12.500 Interdisciplinary Seminar
1972-73 topic, Futures Canada.
Seminar three hours a week, fall and winter terms.
Seminar leader Professor John Porter (Sociology)

Canadian Studies 12.590, 591, 592 Directed Studies
Reading and research tutorials.
Tutorial: 590 fall term, 591 winter term, 592 spring term.

Canadian Studies 12.598 Research Essay

Canadian Studies 12.599 M.A. Thesis

SELECTION OF COURSES

In addition to the graduate courses offered by the Institute, the following selection of courses is open to Master's and Qualifying Year students in Canadian Studies.

Anthropology 54.373 Urban Anthropology
54.470 Indians and Eskimos of North America

Art History 11.305 Canadian Art
11.505 Selected Aspects of Canadian Art History
11.506, 507, 508 Directed Reading and Research

Economics 01.300 Labour Economics
01.304 Public Finance
43.325 The Economic Development of Canada

	01.330	Social Economics
	43.340	Problems of Area Development
	43.357	Introduction to Industrial Relations
	43.465	Industrial Relations
	43.511	The Canadian Economy
	43.512	Workshop on the Canadian Economy
	43.530	Industrial Organization
	43.540	Public Finance
	43.580	Urban Economics
	43.581	Regional Economics

English 18.381 Studies in Canadian Poetry
18.383 Studies in Canadian Fiction
18.387 Selected Topic in Canadian Literature
18.483 Seminar in Canadian Fiction
18.581 Studies in Canadian Poetry
18.583 Studies in Canadian Fiction
18.587 Studies in Canadian Literature

French 20.335 L'essai dans la littérature canadienne-française
20.465 Etude du nationalisme dans ces manifestations littéraires
20.520 Aspects de la littérature canadienne française

Geography 45.305 Geography of Canada
45.320 Urban Geography
45.333 Regional Development and Planning in Canada
45.334 Geography of a Selected Drainage Basin
45.335 An introduction to the historical geography of Canada and the methodology of historical geography
45.341 Transportation Geography
45.351 Geography of the Northlands
45.435 Historical Geography
45.441 Advanced Economic Geography
45.505 and 45.506 Problems in Canadian Resource Development
45.531 Selected Studies in the Human Geography of Arctic and Subarctic Lands
45.535 and 45.536 Problems in Historical Geography
45.544 Recreational Land Use

History 24.330 Social History of Canada
24.332 The Maritime Provinces 1750-1900
24.334 Canada-United States Relations
24.336 Canadian External Relations
24.430 Selected Problems in the Social and Economic History of Upper and Lower Canada
24.432 Seminar on Acadian History
24.433 Selected Problems in the Social and Political Development of Twentieth Century Canada

	47.507	Problems of Canadian Government and Politics: II
	47.510	The Political Process in Canada
	47.520	Nationalism
	47.535	The Canadian and American Political Traditions
	47.540	Problems in Canadian Public Administration
	47.561	Development of Canadian External Relations
	47.562	Issues in Canadian Foreign Policy

Psychology 49.653 Disadvantaged Children

Sociology	**53.320**	French Canadian Society
	53.325	Ethnic Group Relations
	53.345	Stratification and Mobility
	08.346	Canadian Social Structure
	53.451	Substantive Demography
	53.455	Urban Studies
	53.520	Comparative Social Systems
	53.525	Canadian Society
	53.575	Workshop on Contemporary Macro-Sociological, Demographic and Ecological Problems
	53.580	Power and Stratification

With the approval of the Institute, certain other courses may be selected.

ECONOMICS

Chairman of the Department: G. Rich
Supervisor of Graduate Studies: W. I. Gillespie

The Department of Economics offers programs of study and research leading to the M.A. and Ph.D. degrees.

Graduate students in Economics undertake a thorough review of economic theory, together with an analysis of the Canadian economy, its institutions and history, and the working of public policy. Stress is placed on the understanding and application of quantitative methods to all aspects of economics. Although the programs are generally oriented towards policy problems, there is considerable opportunity for the development of specialized interests.

At the time the main areas of specialization within the Department include the following:

Economic Theory	Growth and Development
Mathematical Economics	Economic History
Econometrics	Industrial Organization
Public Finance	Comparative Economic Systems
Monetary Theory	Urban and Regional Economics
International Economics	Labour
Economics of Planning	

QUALIFYING YEAR PROGRAM

Applicants who have a general (pass) bachelor's degree, or who otherwise lack the required undergraduate preparation, may be admitted to a Qualifying Year program designed to raise their standing to Honours status. If successful, they may be permitted to proceed to the Master's program the following year.

Refer to the general section of this Calendar for details of the regulations governing the Qualifying Year.

MASTER OF ARTS

Admission Requirements

The normal requirement for admission to the Master's program is an Ontario Honours B.A. (or the equivalent) in Economics, with at least second class standing.

Applicants are expected to have had an adequate preparation in statistics and mathematics. Credit in the following two undergraduate courses (or their equivalents) will be accepted:

- **Economics 43.220** Statistical Methods in the Social Sciences; and

- **Mathematics 69.100** Introductory Calculus and Algebra OR

- **Mathematics 69.101** Introductory Mathematics

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The Department may require certain applicants to write the Graduate Record Examination Aptitude Test and the Advanced Test in Economics offered by the Educational Testing Service.

Program Requirements

All Master's students in Economics are required to complete the following half-courses:

Economics 43.501 Advanced Micro-Economic Theory
Economics 43.502 Advanced Macro-Economic Theory
Economics 43.503 Welfare Economics
Economics 43.504 Economic Stabilization and Growth Theory

In addition, each candidate must select and complete ONE of the following:

- A thesis, equivalent to two full-courses, and one other full-course. All part-time students must select this option.
- Three approved full-courses, one of which may be selected from among those offered in a related discipline.

All Master's candidates must also undertake one written comprehensive examination. Details of this requirement are outlined below.

Comprehensive Examinations

Master's candidates in Economics must undertake a written comprehensive examination to demonstrate their knowledge of economic theory and its policy implications.

There may also be an optional oral examination designed to give the student an opportunity to expand on the answers and solutions submitted in the written parts.

Academic Standing

The Department requires that Master's candidates obtain a grade of B— or better in each course, on the comprehensive examination, and on the thesis (where applicable).

DOCTOR OF PHILOSOPHY

The Doctoral program in Economics, which must be undertaken on a full-time basis, normally requires two years of study.

Admission Requirements

The normal requirement for admission into the Ph.D. program is a Master's degree (or the equivalent) from a recognized university.

The Department may require certain applicants to write a comprehensive entrance examination.

Program Requirements

Ph.D. candidates are expected to have or acquire proficiency in mathematics and statistics. This requirement must be satisfied before proceeding with the program.

The specific program requirements for the Ph.D. degree are the following:

- **Economics 43.600** Theory of Policy, AND the following compulsory half-courses:

  Economics 43.611 Workshop in Economic Policy

  Economics 43.621 Research Methods

  Economics 43.622 Applied Economics

- Five other graduate half-courses (or the equivalent) in Economics. With the permission of the Supervisor of Graduate Studies, one full-course may be selected from a related discipline.

- A formal dissertation which must be defended at an oral examination.

- Three written comprehensive examinations (theory, policy, and an optional field).

Academic Standing

Ph.D. candidates must obtain a grade of B or better in each course and on the comprehensive examinations.

QUALIFYING YEAR COURSES

Economics 43.590 Micro-Economic Theory

This course is required for Qualifying Year students whose preparation in micro-economic theory is judged to be inadequate for graduate work in Economics at Carleton University.

Seminars two hours a week, fall term.

R. L. Carson

Economics 43.591 Macro-Economic Theory

This course is required for Qualifying Year students whose preparation in macro-economic theory is judged to be inadequate for graduate work in Economics at Carleton University.

Seminar two hours a week, winter term.

K. Marwah

Economics 43.592 Empirical Methods

For Qualifying Year students whose statistical training is judged to be inadequate. It covers the fundamental concepts of statistical analysis and will introduce the student to econometric methods.

Seminar two hours a week, fall and winter terms.

S. J. D. May

Economics 43.594 Qualifying Year Tutorial

A tutorial for Qualifying Year students whose program includes the full slate of Qualifying Year core courses (micro-economic theory, macro-economic theory, empirical methods, and applied economics).

Tutorials, spring term.

E. U. Choudhuri

Economics 43.595 Applied Economics

Lectures two hours a week, fall and winter terms.

Members of the Department

Economics 43.597 Qualifying Year Directed Readings

Directed reading, spring term.

Members of the Department

GRADUATE COURSES

Enrolment in the graduate courses require the permission of the departmental Supervisor of Graduate Studies.

Economics 43.501 Advanced Micro-Economic Theory

The theory of resource allocation, production, and distribution in a static economy. Students will be required to draw upon a variety of mathematical concepts as the need arises.

Seminar two hours a week, fall term.

J. McManus

Economics 43.502 Advanced Macro-Economic Theory

The theory of employment, price determination and income. An examination of the workings and interactions of money, capital, labour and commodity markets. Macro-Economic models will be considered under static and shortrun dynamic conditions. Students will be required to draw upon a variety of mathematical concepts as the need arises.

Seminar two hours a week, fall term.

E. Davis

Economics 43.503 Welfare Economics for Policy

A rigorous exposition of theoretical welfare economics. An introduction to such topics as the role of voting in decision making, the economics of democracy and bureaucracy; the relationship of such forces to the theory of economic policy.

Seminar two hours a week, winter term.

Prerequisite: Economics 43.501.

E. G. West

Economics 43.504 Economic Stabilization and Growth Theory

An examination of balance-of-payments theory, followed by an analysis of Keynesian and neoclassical growth models for closed and open economies. The role of money and international capital flows in the growth process will be discussed.

Seminar three hours a week, winter term.

Prerequisite: Economics 43.502.

E. U. Choudhuri

Economics 43.507, 508, 509 Directed Readings

507 fall term, 508 winter term, 509 spring term.

Prerequisite: Permission of the Chairman of Department.

Members of the Department

Economics 43.511 Canadian Economy

A detailed examination of aspects and problems of the Canadian economy. A variety of topics may be discussed, including the economic development of Canada, the structure of the current national and regional economies, industrial organization, factor market operation, income distribution, the role of international trade and capital flows, and the stability of the economy.

Seminar two hours a week, fall term.

H. E. English

Economics 43.512 Workshop on the Canadian Economy

Economic theory applied to the workings of the Canadian Economy. Empirical estimation of various aspects of factor market operation, production, distribution and aggregate economy. Participants are expected to prepare and present papers for discussion.

Seminar two hours a week, winter term.

Prerequisite: Economics 43.511.

W. I. Gillespie

Economics 43.515 History of Economic Thought

The crucial achievements in economic theory and doctrine in the nineteenth and twentieth centuries are studied. Special emphasis is given to the inter-relationship between the social environment and economic thought — especially to the role of economics in the development of the national state and international institutions.

Seminar two hours a week, fall and winter terms.

J. C. Danielsen and E. G. West

Economics 43.525 Advanced Economic History

A discussion of methodology applicable to the analysis of economic history. Intensive examination of selected topics in North American and West European economic history.

Prerequisite: Economics 43.595.

Economics 43.530 Industrial Organization

An analysis of the organization of Canadian industry, with reference to associated U.S. industry where necessary. A few representative industries are examined in some detail. Price theory is used to distinguish economic from institutional factors affecting the structure of the economy. Emphasis is laid upon public policies which affect, intentionally or otherwise, the organization and behaviour of industry, e.g., public utility regulation, control of restrictive practices, commercial policy, and price supports.

Seminar two hours a week, fall and winter terms.

J. C. Danielsen

Economics 43.535 Labour Economics

An examination of various theories pertaining to labour and the functioning of labour markets. Discussion of the current body of theory and its historical development. Examination of a number of selected pieces of research material (theoretical and applied) in the general area of manpower economics and labour policy.

Seminar two hours a week, fall and winter terms.

C. L. Johnson

Economics 43.540 Public Finance

A discussion of the theory of public finance, and an examination of several empirical attempts to quantify the theory. Some topics of current interest concerning the public sector in the Canadian economy are examined in the light of the theory and empirical findings.

Seminar two hours a week, fall and winter terms.

W. Hettich

Economics 43.545 Capital Theory

Seminar two hours a week, fall term.

T. K. Rymes

Economics 43.546 Economic Dynamics: Growth

An introduction to modern theories of the growth of income. The simple "razor's edge" growth theory of Harrod will lead to an examination of the neoclassical growth theorems. Golden Rules of Accumulation; the role of money in growth and the effects of debtor-creditor position of growth in an open economy will be analyzed, together with policies for growth and growth paradoxes.

Seminar two hours a week, spring term.

T. K. Rymes

Economics 43.556 Economic Development

An inquiry into the reasons for the failure of most societies to achieve economic development. Reference to the experience of now developed countries will be made. The role of planning, trade, aid and regional integration as possible development strategies will be evaluated.

Seminar two hours a week, fall and winter terms.

Economics 43.560 International Trade

An examination of the theory of international trade and payments and its applications. The current body of theory and its historical development are discussed, as are a number of attempts to verify and quantify the theory. A number of present day problems, policies, and institutions are examined in the light of the theory and empirical findings.

Seminar two hours a week, fall and winter terms.

K. A. L. Acheson

Economics 43.566 Monetary Economics

A treatment of contemporary monetary theory emphasizing the theory of demand and supply of money and the dynamics of monetary disturbances.

Seminar two hours a week, fall and winter terms, evening division.

M. D. Bordo and J. Chant

Economics 43.570 Comparative Economic Systems

An analysis of the structure and functioning of economic systems. Some discussion of the notion of an economic system and of the criteria used to evaluate the performance of systems.

Seminar two hours a week, fall and winter terms.

R. L. Carson

Economics 43.575 Mathematical Economics

A synthesis of some important topics in economic theory, with almost exclusive use of mathematical models. Some of these are: general equilibrium of the firm and/or the household, and related matters; general equilibrium of exchange and production; stability of equilibrium; linear programming, games, and the theory of the firm; selected topics in economic dynamics; value theory; social welfare functions; optimizing techniques and public policy.

Seminar two hours a week, fall and winter terms.

Prerequisite: Mathematics 69.201, Economics 43.200, 43.210 or equivalent.

May be taken by senior undergraduates, with permission of Chairman and the instructor.

K. Marwah

Economics 43.580 Urban Economics

An inquiry into the internal dynamics of cities and inter-urban relationships primarily through directed research.

Seminar two hours a week, fall and winter terms.

N. H. Lithwick

Economics 43.581 Regional Economics

An examination of theories, problems and policies as they relate to regional economic issues with particular reference to the Canadian scene and the role of the federal government.

Lectures and seminars two hours a week, fall and winter terms.

T. N. Brewis

Economics 43.585 Econometrics

Introduction to problems of structural estimation of economic models; single equation estimation and related problems; simultaneous estimation for inter-dependent systems of linear form; non-linear estimation; Monte Carlo experiments to derive small sample properties of estimators. Some project in structural estimation will be undertaken or assigned.

Seminar two hours a week, fall and winter terms.

S. B. Park

Economics 43.599 M.A. Thesis

Economics 43.600 Theory of Policy

An analysis of the theoretical foundations of policy. The welfare implications of policy measures in closed and open economies. Examination of the formulation, objectives, role, and interrelationship of economic policy.

Seminar two hours a week, fall and winter terms.

E. Davis and J. Chant

Economics 43.611 Workshop in Economic Policy

Forums in which graduate students and faculty can work together on policy questions. Workshops will be held in the following fields; Economic History; Economic Organization and Development; Management Sciences; Money and Trade; Public Economics; and Quantitative Methods. Doctoral students are required to join two workshops and present a paper to one of these groups.

Workshops, fall and winter terms.

Members of the Department

Economics 43.621 Research Methods

A seminar on research methods used in advanced economic analysis. Mathematical, statistical and econometric tools will be developed as required.

Seminar two hours a week, fall term.

S. May

Economics 43.622 Applied Economics

A seminar concerned with the application of research methods to economic problems. Literature will be reviewed, and selected topics will be examined in depth.

Seminar two hours a week, winter term.

G. Rich

The courses listed below indicate the areas in which members of the Department are prepared to supervise directed reading, research and seminars. Not all of the courses will necessarily be offered in any one year.

Economics 43.631 Seminar in Industrial Organization
Prerequisite: Economics 43.530 or equivalent.

Economics 43.641 Seminar in Public Finance
Prerequisite: Economics 43.540 or equivalent.

Economics 43.646 Seminar in Growth and Capital Theory
Prerequisite: Economics 43.545 or 43.546 or equivalent.

Economics 43.656 Seminar in Economic Development
Prerequisite: Economics 43.556 or equivalent.

Economics 43.661 Seminar in International Economics
Prerequisite: Economics 43.560 or equivalent.

Economics 43.666 Seminar in Monetary Analysis
Prerequisite: Economics 43.504, 43.566 or equivalent.

Economics 43.671 Seminar in Comparative Economic Systems
Prerequisite: Economics 43.570 or equivalent.

Economics 43.676 Seminar in Mathematical Economics
Prerequisite: Economics 43.575 or equivalent.

Economics 43.681 Seminar in Urban and Regional Economics
Prerequisite: Economics 43.580 or equivalent.

Economics 43.686 Seminar in Econometrics
Prerequisite: Economics 43.585 or equivalent.

Economics 43.696 Seminar in Operations Research
Seminar two hours a week, winter term.
Prerequisite: Economics 43.575 or equivalent.

Economics 43.697 Selected Advanced Topics
Prerequisite: Permission of Chairman of the Department.

Economics 43.699 Ph.D. Thesis

GEOGRAPHY

Chairman of the Department: D. M. Anderson
Supervisor of Graduate Studies: D. R. F. Taylor

The Department of Geography offers programs of study and research in physical and human geography and interrelated topics, leading to the degree of Master of Arts.

Programs for graduate students are planned on the basis of individual interests, and selection of appropriate courses in related departments is encouraged. An advisory committee, consisting of the research supervisor and two other faculty members, will assist each graduate student.

At the present time, the main areas of specialization in the Department are the following:

Physical Geography

Studies of natural processes close to earth's surface; climate-ground interaction; micrometeorology in frozen ground regions; the chemical, physical and thermodynamic properties of soils and sediments; hydrology and sedimentology of fluvial processes in glacial and periglacial environments. Current emphasis in investigations of geotechnical concern are cold region phenomena, soil water relations and stability of marine clays. (J. P. Johnson, M. W. Smith, J. K. Torrance, T. P. Wilkinson, P. J. Williams)

Cultural and Historical Geography

The effect of cultural attitudes and techniques on the evolution of human groups, their organization of earth's space and resources in past and present landscapes, cross-cultural studies focusing particularly on the role of authority and ideology in changing the physical environment, land tenure and use of land resources. (J. Clarke, D. B. Knight, G. C. Merrill, D. R. F. Taylor, P. E. Uren)

Urban and Economic Geography

Identification of basic regularities in the areal distribution and socio-economic aspects of human activity and the processes underlying them; theory of location functions, internal structures of urban places, nature of transport systems, and determinants of industrial location. (D. Bennett, J. E. Tunbridge, I. Wallace)

Rural and Resource Development

Identification of development processes in the rural milieu; the interplay of population, political, demographic, socio-economic variables with land resources and spatial factors. Frontier settlement, rural-urban evolution in developing countries, and recreational land use are of particular interest. (D. M. Anderson, D. P. Fitzgerald, D. R. F. Taylor, P. E. Uren)

Systematic interests of department members are applied to regions of special interest: Africa (Knight, Taylor), South East

Asia and South West Pacific (Fitzgerald, Knight), Arctic and Subarctic (Fitzgerald, Smith, Johnson, Williams), Europe and U.S.S.R. (Uren), Canada (Anderson, Clarke, Johnson, Knight), Caribbean (Merrill).

The department has a strong interest in and facilities for cartography and computer mapping including an XY digitizer and access to related systems (D. R. F. Taylor). Excellent laboratory facilities are equipped for rigorous study of near-surface processes and the physics, chemistry and thermodynamics of earth materials. Four full time laboratory and library support staff. Specialists from the Federal Government offer lectures at regular intervals, and there is a valuable interchange of information and experience with other institutions.

QUALIFYING YEAR PROGRAM

Applicants who have a general (pass) bachelor's degree, or who otherwise lack the required undergraduate preparation, may be admitted to a Qualifying Year program. Refer to the general section of this Calendar for details of the regulations governing the Qualifying Year.

MASTER OF ARTS

Admission Requirements

The normal requirements for admission to the Master's program are outlined in the general regulations section of this Calendar.

Applicants for programs in fields of specialization in physical geography are expected to have taken undergraduate courses in the physical sciences or engineering, as well as in physical geography, or geology. Applicants in human geography may be accepted from related fields, if their proposed subjects of study are closely related to faculty research experience. Students with deficiencies relative to their program may be required to take additional courses.

Program Requirements

The requirements of the Master's program in the Department of Geography are as follows:

- Three full-courses, or the equivalent, selected in consultation with the Department.
- A reading knowledge of a language other than English.
- A thesis (Geography 45.599) which must be defended at an oral examination.

GRADUATE COURSES

In addition to the selection of courses offered by the Department, graduate students in Geography are encouraged to consider, in partial fulfillment of their degree requirements, appropriate courses offered in such disciplines as Biology, Chemistry, Economics, Engineering, Geology, History, International Affairs, Physics, Political Science and Sociology.

Geography 45.500, 501, 502 Graduate Research Seminar
A seminar on contemporary research themes in geography.
Prerequisite: Permission of chairman and instructor required.
Seminar three hours a week, 500 fall term, 501 winter term, 502 spring term.
Members of the Department and visitors

Geography 45.505, 506 Problems in Canadian Resource Development
Focus on geographic aspects of specific Canadian Development problems.
Seminar and discussion, three hours a week, 505 fall term, 506 winter term.
Lecturer to be announced

Geography 45.510 Channel Form and Process
Hydraulic geometry, alluvial morphology and palaeomorphs of channel activity.
Seminar and discussion three lecture hours a week, one term.
T. P. Wilkinson

Geography 45.512 Experimental Geomorphology
Instrumental techniques for investigation of hydrological and thermal processes near the earth's surface. Laboratory and field procedures concerned with soil-water free energy relationships.
Prerequisite: Geography 45.413 or permission of the instructor.
Lectures, seminars and laboratory five hours a week, fall term.
P. J. Williams

Geography 45.513 Laboratory Instrumentation and Workshop Procedures
The use of standard analytical equipment, and the design, construction and operation of apparatus for investigation of physical properties of earth materials.
Lectures, seminars and laboratories five hours a week, winter term.
Members of the Department

Geography 45.514 Periglacial Geomorphology
Permafrost, its distribution and significance; seasonal ground freezing; ground thermal regime; the physical and thermodynamic properties of freezing and thawing soils; terrain features ascribable to frost action; solifluction and patterned ground.
Prerequisites: Geography 45.411 and Geography 45.413, or permission of the instructor.
Lectures, seminars and laboratory five hours a week, winter term.
Not offered 1973-74

Geography 45.515 Glaciology
The study of ice and snow in all its aspects. (Also listed as Geology 67.545)
Lectures three hours a week, fall and winter terms.
A. D. Stanley and R. O. Ramseier

Geography 45.516 Properties of Soils in Relation to Soil Chemistry
Lectures two hours, laboratory three hours a week, winter term.
J. K. Torrance

Geography 45.518 Field Studies and Methodological Research
Field acquisition and analysis of geographic material. Supervised field ob-
servations and methodology related to thesis research. Individual or group
basis.
Seminar and discussion three hours a week, fall and winter terms, or spring
term.
Members of the Department

Geography 45.525, 526 Computer Mapping
A consideration of computer mapping techniques and practical application
of these techniques.
Seminar and discussion three hours a week, 525 fall term, 526 winter term.
D. R. F. Taylor
526 winter term not offered 1973-74

Geography 45.530 Problems of African Development
A consideration of the problems of development facing African countries
today and an analysis of the developmental approaches possible.
Seminars three hours a week, fall and winter terms.
Not offered 1973-74

Geography 45.531 Selected Studies in the Human Geography of Arctic
and Subarctic Lands
A seminar with emphasis on the social and economic development problems
of the Canadian and Soviet Arctic and subarctic.
Seminar two hours a week, winter term.
Not offered 1973-74

Geography 535, 536 Problems in Historical Geography
Seminar and discussion three hours a week, 535 fall term, 536 winter term.
536 winter term not offered 1973-74
J. Clarke

Geography 45.543 Land Resource Theory
A seminar in concepts relating to land use. Work of von Thunen, Dunn,
Alonzo, Krutilla, Kneese, Barlowe, Clawson and Firey to be examined and
related.
Seminars three hours a week, fall term.
Not offered 1973-74

Geography 45.544 Recreational Land Use

This course will explore post World War II trends in recreational land use, and review problem areas and current research activity in this field.

Seminars three hours a week, winter term.

D. M. Anderson

Geography 45.550 Selected Studies of Frontier Settlement

A seminar on the characteristics of settlement along the edge of the ecumene. Special emphasis will be placed on frontier settlement in the Canadian subarctic, tropical Asia, and the dry lands of the Middle East.

Seminars two hours a week, fall term.

Not offered 1973-74

Geography 45.560 Selected Problems in Cultural Geography

A course designed to permit a student to pursue selected problems in cultural geography. This course will be run on a seminar basis.

Seminar three hours a week, fall and winter terms.

D. B. Knight and G. C. Merrill

Geography 45.580 Problems in Asian Development

Analysis of problems of rural development chiefly in South East Asia and the Himalayan Kingdoms.

Seminar and discussion two hours a week, winter term.

Not offered 1973-74

Geography 45.590, 591, 592 Graduate Tutorial

A field will be selected for study, through tutorials, on an individual basis. Permission of chairman and instructor required.

Tutorial three hours per week, 590 fall term, 591 winter term, 592 spring term.

Members of the Department

Geography 45.599 M.A. Thesis

INTERNATIONAL AFFAIRS

Director of the School: Philip E. Uren
Associate Director: Michael G. Fry

The School of International Affairs, established in 1965 with the generous support of the Hon. Norman M. Paterson, offers a program of studies leading to the M.A. degree.

In particular the program focuses on three themes — **international integration; political, economic, and social development;** and **conflict.** In the analysis of these phenomena, particular attention is paid to the role of international institutions, Canadian and comparative foreign policy, and to selected regional studies. The School maintains close cooperation with the Institute for Soviet and East European Studies (see p. 000) and with committees designed to encourage and coordinate faculty and student interests in Africa, Asia, and Latin America. The chairmen of these committees are: on Africa, Professor Fraser Taylor; on Asia, Professor Elliot Tepper; and on Latin America, Professor A. Ritter.

QUALIFYING YEAR PROGRAM

The Qualifying Year program is designed to enable students with a second class standing but with inadequate background in the disciplines relevant to the M.A. program to make up their deficiencies. Candidates with a general (pass) bachelor's degree in History, Political Science, Economics, or closely related disciplines, and those with an Honours bachelor's degree in another discipline, may be required to take three to five qualifying year courses before being eligible to enter the Master's program.

In addition, students in the Qualifying Year may wish to select an area emphasis and to take courses that will enable them in the M.A. year to engage in some specialized study in the problems of a region having particular relevance to the theme they have elected to stress.

Program Requirements

For students electing the *integration* theme, two courses are normally required for the admission to the M.A. year if equivalent courses have not been included in the student's previous academic program: Economics 43.361 (half course) and Political Science 47.460. Also recommended for these students are at least two courses relating to a region where the nature and effects of integration may be studied, e.g., courses bearing on Canada-United States relations, the European Economic Community, Comecon, or some "third world" integration arrangement.

For those intending to study *development,* the following courses will normally be required: Economics 43.361 and 363 (half courses), and at least one course in Geography, Political Science, or Sociology and Anthropology relevant to this theme (e.g. Anthropology 54.230). Particularly recommended for these

students are courses on one of the developing regions (Geography 45.330 or 380, Political Science 47.310 or 315, and Anthropology 54.362).

For those intending to study *conflict,* the following courses are recommended: History 24.380 or 480, Political Science 47.460, and Sociology 53.340 or 300. Also recommended are courses dealing with other approaches to conflict or with regions in which the student may wish to apply the analysis of conflict.

In many of the above cases, an appropriate language course may be recommended.

MASTER OF ARTS

Admission Requirements

The normal requirement for admission into the Master's program is an Honours bachelor's degree in History, Political Science, or Economics, with at least second class standing. However, one or two additional courses may be required if a student's previous program has not included prerequisites related to the interdisciplinary theme selected (See the Qualifying Year).

Program Requirements

Candidates who lack the required background in international affairs will be expected to take additional courses.

The normal program requirements for M.A. students in International Affairs are the following:

- At least one interdisciplinary core seminar selected from the following:
  International Affairs 46.500 International Integration
  International Affairs 46.505 Economic, Political, and Social Development
  International Affairs 46.515 Conflict Resolution
  Each of these core seminars is valued at one unit of credit (one full-course).
- Two other approved courses (or the equivalent) in International Affairs or related disciplines.
- A thesis (valued at two credits) involving original research on an approved subject in the field of international affairs.
- An ability to read and write in French (or in certain cases a major language other than French or English) with moderate fluency. A reading knowledge test will normally be required.
- An oral comprehensive examination primarily on the thesis and core seminar to determine the candidate's ability to relate various disciplines to the study of international affairs.

Academic Standing

A grade of B− or better must be obtained in each course counted for credit towards the Master's degree.

GRADUATE COURSES

International Affairs 46.500 International Integration
The study of political, economic, and social integration of nations, with particular emphasis currently on Western Europe and North America.
Seminar three hours a week, fall and winter terms.
D. M. L. Farr, P. V. Lyon, B. A. McFarlane and others

International Affairs 46.505 Political and Economic Development
The study of the principles and problems of development in the less industrially advanced regions of the world.
Seminar three hours a week, fall and winter terms.
J. R. Nellis, D. I. Pool, A. R. Ritter, D. R. F. Taylor and E. L. Tepper

International Affairs 46.515 Seminar on Conflict Resolution
Seminar three hours a week, fall and winter terms.
D. Forcese, M. G. Fry, H. von Riekhoff, and others

International Affairs 46.520, 521 Studies in Strategy and Security
Selected topics on the theory and practice of strategy and peace-keeping.

520 — Lectures and seminars three hours a week, fall term.
Kurt Gasteyger

521 — To be announced

International Affairs 46.525, 526, 527 Selected Topics in International and Regional Studies

525 — Lectures and seminars three hours a week, fall term.

Section A — Topics in Integration and Development
Lecturer to be announced

Section B — Integration in Eastern Europe
C. McMillan, H. Selucky, P. Uren

Section C — Foreign Policies and Conflict in Southern Africa
D. Anglin, M. MacDonald

Section D — Foreign Policies of East Asian Countries
Lecturer to be announced

Section E — Evolution of Canada's External Relations
P. V. Lyon

Section F — Canada's International Economic Policies
A. F. W. Plumptre

526 — Lectures and seminars three hours a week, winter term.

Section A — Integration in Developing Countries
Lynn Mytelka

Section B — Development Problems in South and East Asia
B. B. Thapa

Section C — Development Problems in Latin America
Lecturer to be announced

Section D — Issues in Canadian Foreign Policy
P. V. Lyon

Section E — Foreign Policies and Conflict in Eastern Europe
G. Neuspiel, H. Selucky

Section F — To be announced
Lecturer to be announced

527 — Seminars five hours a week, summer session
Not offered 1973

International Affairs 46.530 The International Enterprise
This course will examine recent economic and political developments in the fields of international trade and investment as they relate to the operations of international enterprises. The impact of international enterprises on host countries and the policy response of host governments will be examined with special attention devoted to the Canadian situation.
Seminar three hours a week, fall and winter terms.
C. J. Maule

International Affairs 46.591, 592, 593 Tutorials in International Affairs
Tutorials, 591 fall term, 592 winter term, 593 spring term
Times to be arranged.

International Affairs 46.599 M.A. Thesis

SELECTION OF COURSES
   In addition to the graduate courses offered by the school the following selection of courses is open to Master's and Qualifying Year students in International Affairs.

<div align="center">Courses in International Relations</div>

Economics	**43.361**	Introduction to International Trade
	43.362	International Monetary Problems
	43.363	Introduction to Economic Development
	43.364	The Economics of Planning
	43.460	International Trade

History **24.280** The Great Powers, 1789-1890
24.336 Canadian External Relations
24.380 Diplomacy of the Great Powers, 1890-1945
24.334 Canada-United States Relations
24.480 Selected Problems in the Diplomacy of the Great Powers, 1906-1939
24.481 Diplomatic and Strategic Problems of the Second World War

Law **51.420** International Economic Law I
51.421 International Economic Law II
51.463 Public International Law
51.467 Advanced International Legal Problems
51.491 Tutorial in Law

Political Science **47.260** International Politics
47.360 International Institutions
47.365 Comparative Foreign Policies
47.366 Canadian Foreign Policy
47.460 Theories of International Relations
47.461 Soviet Foreign Policy
47.466 American Foreign Relations
47.561 Development of Canadian External Relations
47.562 Issues in Canadian Foreign Policy
47.567 U.S. Foreign Policy Decision-Making
47.571 Soviet-American Relations
47.581 Foreign Policies of African States
47.582 International Politics of Africa
47.583 Foreign Policies of the Major Far Eastern Powers
47.585 Contemporary International Politics
47.586 Military Strategy and Defence Policy
47.587 Problems in International Organization
47.590 Tutorial in a Selected Field

Related Courses

Anthropology **54.362** Contemporary Societies in Africa

Economics **43.370** The Economics of Socialism
43.456 Economic Development
43.470 Comparative Economic Systems

Geography **45.350** Western Europe
45.330 Developing Nations in Intertropical Africa
45.360 Soviet Union
45.361 East Europe
45.380 Developing Nations of Asia
45.440 Political Geography
45.530 Problems of African Development
45.580 Problems in Asian Development

History **24.260** History of Russia and the USSR
24.318 German Unity and Nationality
24.341 Contemporary America: 1940 to the Present
24.365 History of Eastern Europe
24.460 Selected Problems in Russian History

Political Science **47.210** Government and Politics in Western Europe
47.220 Government and Politics in the United States
47.310 Government and Politics in Africa
47.315 Government and Politics of South and Southeast Asia
47.320 Soviet Government and Politics
47.333 or **47.430** Modern Political Thought
47.415 Eastern European Politics
47.462 International Communist Movement
47.505 Comparative Government
47.520 Nationalism
47.545 Public Administration in Developing Countries
47.550 Problems in Western European Politics

Sociology **53.340** Conflict and Society
53.360 Social Change and Modernization
53.520 Comparative Social Systems
53.540 Political Sociology
53.587 Sociology of International Relations

Soviet Studies **55.500** Interdisciplinary Seminar on the Soviet Union and Eastern Europe

LAW

Chairman of the Department: J. George Neuspiel

The Department of Law offers one course at the graduate level. Members of the Department occasionally supervise graduate theses for students in other departments.

GRADUATE COURSE

Law 51.555 Law of Public Authorities II

The techniques by which administrative action is controlled; internal review and appeal; judicial and non-judicial controls; consideration will also be given to the roles of the legislature, parliamentary commissioner, Council on Tribunals, Conseil d'Etat, official inquiries, interest groups and public opinion.

Prerequisite: Permission of the Department.

Seminars three hours a week, evening division.

POLITICAL SCIENCE

Chairman of the Department: To be announced
Supervisor of Graduate Studies: Kenneth D. McRae

The Department of Political Science offers programs leading to the M.A. and Ph.D. degrees.

Specialized graduate study and research are currently available in the fields of Political Theory, Canadian Government and Politics, Comparative . Government and Politics, International Relations, and Public Administration.

QUALIFYING YEAR

Applicants who have a general (pass) B.A. in Political Science, with high standing (grade point average of at least 7.0) may be considered for admission to a Qualifying Year program. Candidates who complete the Qualifying Year with at least B standing (grade point average of 8.0, with no more than two grades below B— and none below C—) may be allowed to proceed to the Master's program the following year.

Refer to the general section of this Calendar for details of the regulations governing the Qualifying Year.

MASTER OF ARTS

Admission Requirements

The normal requirement for admission to the Master's program is an Honours B.A. (or the equivalent) in Political Science, with at least B standing. This will normally mean a Carleton grade point average of 8.0 taking into account both transcript and letters of reference.

Honours graduates in fields other than Political Science will be considered on the basis of their academic background and standing. Those with deficiencies may be required to take additional courses or to register in the Qualifying Year program.

Program Requirements

All Master's candidates will enrol in an approved number of courses in Political Science including political theory and political inquiry if not already taken. No more than two of these courses may be below the 500 level, and no more than one below the 400 level.

Each candidate, in consultation with the Department, will select and follow one of the following three optional program patterns:

- Five full-courses (or the equivalent) in Political Science.
- Four full-courses (or the equivalent) in Political Science, AND a research essay on a topic related to one of the courses.

- Three full-courses (or the equivalent) in Political Science AND a research thesis, equivalent to two full-courses, in an approved field. Students who already have a Master's degree (including a thesis) in another discipline may substitute two graduate courses for the Political Science thesis.

All Master's candidates in Political Science must also undertake a comprehensive oral examination on approved major and minor fields. Details of this examination are outlined below under *Comprehensive Examination*.

All candidates must also demonstrate a reading knowledge of French. Students from outside Canada may substitute another main language in place of French. Language tests are conducted twice a year, in October and February.

A supervisor will be assigned to each candidate to advise and assist in the preparation for the comprehensive and language examinations.

Comprehensive Examination

All Master's candidates in Political Science must undertake an oral comprehensive examination on approved major and minor fields chosen from the following list:

Political theory.
Canadian government.
Comparative government.
Political behaviour and the political process.
Public Administration.
International relations.
Public law (Minor).
Provincial and local government (Minor — unless the major is Canadian government).
Soviet or African studies (Minor).
An approved field in a related discipline (Minor).

Academic Standing

All Master's candidates must obtain at least B standing (grade point average of 8.0). One grade of C+ or C (but not C−) may be allowed.

DOCTOR OF PHILOSOPHY

The Doctoral program in Political Science may be undertaken only on a full-time basis.

Admission Requirements

The normal requirement for admission to the Ph.D. program is a Master's degree (or its equivalent) in Political Science, Public Administration, or International Affairs, with at least high second class standing. This will normally mean a Carleton equivalent grade point average of 9.5 taking into account both transcript and letters of reference.

Program Requirements

The normal program requirements for Ph.D. candidates are outlined in the general regulations sections of this Calendar.

All students are required to have or acquire an adequate basic knowledge of political theory, political inquiry, and Canadian government, regardless of their field of specialization, and an acquaintance with disciplines closely related to Political Science. They will also be expected to undertake further work in statistics if statistical proficiency is needed for the preparation of the thesis.

The specific program requirements for Ph.D. candidates in Political Science are the following:

- At least three graduate full courses (or the equivalent). A grade point average of at least 9.0 must be obtained in these courses before proceeding to the comprehensive examinations. Additional courses may be required for candidates whose background or standing is deficient.
- **Political Science 47.690** (Ph.D. Tutorial).
- Proficiency in languages, as outlined below under *Language Requirement*.
- Comprehensive examinations in three fields, as outlined below under *Comprehensive Examinations*.
- A thesis, written in English or French, which must be defended in English at an oral examination. This examination may include material related to the general field of the thesis.

The completion of the Ph.D. program will normally require at least two years of full-time study beyond the Master's degree.

A supervisor and two other advisers will be assigned to each Ph.D. candidate to advise him on his studies. The student's entire program must be approved by the Department.

Language Requirement

All Ph.D. candidates must demonstrate an ability to read and translate French easily and to converse in French with moderate fluency.

Candidates from outside Canada may be permitted to offer a reading knowledge of another main language in place of French. Language tests are conducted twice a year, in October and February.

All candidates must also be able to read a third language appropriate to their program. In lieu of this third language, the Department will accept credit in one of the following combinations:

- **Computing Science 95.101** Basic Computer Programming AND **Economics 43.220** Statistical Methods in the Social Sciences.
- **Computing Science 95.101** Basic Computer Programming AND **Mathematics 69.250** Introduction to Statistical Analysis.

These requirements must be completed before the comprehensive examination.

Comprehensive Examinations

All Ph.D. candidates must undertake the following examinations:

- A written examination in one approved major field, covering a general knowledge of the field and two approved areas of specialization.
- An examination in each of two approved minor fields, covering general knowledge and one approved area of specialization in each field. Minor examinations may be oral or written, at the student's option.
- A final oral comprehensive examination integrating the three fields.

Candidates will be expected to successfully complete these examinations before beginning the thesis. The fields of study for the Ph.D. examinations are to be chosen from the following list.

- **Political Theory:** A general knowledge of either historical and normative theory or analytical and empirical theory, with emphasis on one or two sub-fields from the following two lists. A student selecting Political Theory as a *major field* must include one sub-field from *each* list.

  Historical and Normative Theory: ancient political thought (mainly Greek and Roman); medieval political thought (Augustine to about 1500); western political thought (Machiavelli to Burke); western political thought (Bentham to the 20th century); contemporary political thought (including the leading ideologies of the present day); Canadian and American political thought and its immediate European background.

  Analytical and Empirical Theory: quantitative research design and data analysis; methodology and theory construction in political science; conceptual analysis in political theory; philosophy of social science (with special reference to political science).

- **Canadian Government and Politics:** A general knowledge of Canadian political ideas, institutions and processes, with emphasis on one or two of the following: federalism; the parliamentary system; political behavior (with specialization in two of the following — political parties, interest groups, voting and elections, political culture and political socialization); provincial government and politics; local government and politics; and public administration.

- **Comparative Government and Politics:** A general knowledge of the theories and methodology of comparative politics with emphasis on one or two sub-fields from the following two lists:

    Countries or Areas: Western Europe, U.S.S.R. and/or Eastern Europe; United States; Africa; or an approved combination of countries or areas.

    Topics or Themes: political development and integration; political stability and change; federalism; legislatures; local government and politics; multiculturalism and the politics of ethnicity; political parties and interest groups; public opinion and voting behavior; policy analysis.

- **International Relations:** A general knowledge of international theory, international institutions and world history since 1914, with emphasis on one or two of the following: analytical international theory; foreign policies of particular states; international institutions and law; international integration; conflict resolution and peace research; strategic studies.

- **Public Administration:** A general knowledge of theory, including comparative theory, and of practice in Canada, Britain and the United States, with emphasis on one or two of the following topics: theories of administration and organization; Canadian administration (including some knowledge of provincial and municipal administration); comparative public administration (with reference to either developing or developed countries, or an approved combination of countries); administrative responsibility (including judicial controls).

- A minor field in a discipline related to Political Science may be chosen, with the approval of the departmental Graduate Studies Committee.

SELECTION OF COURSES

Within the scope of the regulations, the following undergraduate courses (fully described in the Undergraduate Calendar) may be taken by graduate students:

Political Science	47.400	Institutions of the Government of Canada
	47.401	Policy Making in Canada
	47.402	Policy Seminar
	47.403	Politics and the Media
	47.404	Interest Groups in Canadian Politics
	47.405	Federalism
	47.406	Legislative Process in Canada
	47.409	French Canadian Politics
	47.410	Political Process in Developed Democracies
	47.415	Eastern European Politics
	47.420	President and Congress in the United States
	47.421	Parties and Pressure Groups in the United States

47.422	American Constitutionalism
47.430	Modern Political Thought
47.431	Marxist Thought
47.432	Contemporary Communist Thought
47.435	The Conflict of Ideas in Contemporary Society
47.460	Theories of International Relations
47.461	Soviet Foreign Policy
47.462	International Communist Movement
47.466	American Foreign Relations
47.470	Political Research Design and Data Analysis

Except where an M.A. student is permitted to take a minor in another discipline, a graduate student may take no more than one course in another Department, School or Institute, in fulfilment of the M.A. or Ph.D. requirements.

GRADUATE COURSES

Political Science 47.500 Problems of Canadian Local Government and Politics

A research seminar on selected problems.

Seminar three hours a week, fall term.

Not offered 1973-74

Political Science 47.501 Problems of Canadian Provincial Government and Politics

A research seminar on selected problems.

Seminar three hours a week, winter term.

Prerequisite: Political Science 47.200 or permission of the instructor.

J. H. Pammett

Political Science 47.502 Comparative Local Government

The system of local government in the United States, Britain and France (which have provided prototypes for many other countries), and systems in other countries, chosen according to the interests of the students.

Seminar three hours a week, fall term, day and evening divisions.

Not offered 1973-74

Political Science 47.504 Urban Politics

A seminar on problems of urban politics with special reference to Canada.

Seminar three hours a week, fall term, day division.

D. C. Rowat

Political Science 47.505 Comparative Government

A research seminar dealing in the fall term with theories, methods and problems of comparison, and in the winter term with particular themes.

Seminar three hours a week, fall and winter terms.

C. Ake

Political Science 47.506 Problems of Canadian Government and Politics: I
A research seminar on selected problems.
Seminar three hours a week, fall term.
M. S. Whittington

Political Science 47.507 Problems of Canadian Government and Politics: II
A research seminar on selected problems.
Seminar three hours a week, winter term.
D. C. Rowat

Political Science 47.510 The Political Process in Canada
An analytical study of the democratic political process, with particular reference to political parties and elections, pressure groups and political leadership in Canada.
Seminar three hours a week, fall and winter terms.
K. Z. Paltiel

Political Science 47.515 Problems in Communist Politics
A research seminar in selected problems in the politics, government, and society of Communist political systems with emphasis on the decision-making process and the operation of social and economic restraints.
Seminar three hours a week, fall term.
Prerequisites: Political Science 47.100, 47.320 and 47.332 or permission of the instructor.
T. R. Harmstone

Political Science 47.516 Selected Problems in Soviet Politics
A seminar on selected aspects of the Soviet political system with special attention to the interrelationship between politics, culture and society in the U.S.S.R.
Seminar three hours a week, winter term.
Prerequisites: Political Science 47.100, 47.320 and 47.332 or permission of the instructor.
B. R. Bociurkiw

Political Science 47.520 Nationalism
A seminar on the historical and comparative study of nationalism, with emphasis on its role in the promotion of political change and its impact in selected plurilingual states.
Seminars three hours a week, fall and winter terms.
K. D. McRae and E. L. Tepper

Political Science 47.525 Problems in American Government
Selected issues of constitutional growth and interpretation; co-operation and conflict in decision-making; recent developments in the Presidency. Congress, electoral behavior, public opinion analysis.
Seminar three hours a week, fall and winter terms.
Teresa R. Harmstone

Political Science 47.530 Analytical Political Theory

The role of theory in the study of politics and the major concepts used in political analysis. The possibilities and limitations of the historical, institutional, positivist, functional, and behavioral approaches will be emphasized.

Seminar three hours a week, fall and winter terms.

W. A. Mullins and J. M. Vickers

Political Science 47.531 Selected Topics in the History of Political Thought

A seminar on some important authors and schools of thought, from Plato to the present. The emphasis is on traditional and normative political theory.

Seminar three hours a week, fall and winter terms.

H. B. Mayo and C. Ake

Political Science 47.532 Selected Topics in Political Theory

The content of this course may change from year to year. Concept of ideology will be considered, and its role in the explanation of political phenomena. Special attention will be paid to problems of operationalization.

Seminar three hours a week, fall term.

W. A. Mullins

Political Science 47.533 Selected Topics in Political Theory

The content of this course may change from year to year. Work will centre largely upon problems in the theory of democracy.

Seminar three hours a week, winter term.

Not offered 1973-74

Political Science 47.535 The Canadian and American Political Traditions

A seminar on the interpretation of the American, English Canadian and French Canadian political traditions, with emphasis on their comparative development.

Seminar three hours a week, fall and winter terms, evening division.

K. D. McRae and P. L. Rosen

Political Science 47.540 Problems in Canadian Public Administration

A seminar on selected issues and problems.

Seminar three hours a week, fall and winter terms, evening division.

Prerequisites: Political Science 47.340 or permission of the instructor.

R. J. Van Loon

Political Science 47.544 Public Administration in Developed Western Countries

A seminar in comparative public administration with emphasis on Commonwealth countries, the U.S.A., France and Western Germany.

Seminar two hours a week, fall term, day and evening divisions.

Prerequisites: Political Science 47.446 or permission of the instructor.

D. C. Rowat

Political Science 47.545 Public Administration in Developing Countries

A seminar on the literature and characteristics of development administration; comparison by region, country, and topic, with emphasis on the English-speaking developing countries.

Seminar three hours a week, winter term.

Prerequisites: Political Science 47.446 or permission of the instructor.

J. R. Nellis

Political Science 47.546 Theories of Public Administration

An analysis of early and modern theories of organization, administrative behavior, bureaucracy, and democratic administration; theories of comparison; and the theoretical and analytical aspects of such topics as: public versus private administration, formal and informal organization, decentralization, morale and leadership, planning, budgeting, decision-making, innovation, 'participatory' administration, and administrative responsibility.

Seminar three hours a week, fall and winter terms, evening division.

D. C. Rowat and V. S. Wilson

Political Science 47.550 Problems in Western European Politics

This course will deal intensively with politics in Britain, France, Germany, Italy, and selected minor European powers both democratic and authoritarian.

Seminar three hours a week, fall and winter terms.

Prerequisites: At least one course beyond Political Science 47.100 on democratic or authoritarian governments, and either a comparative theory or a methodology course.

R. J. Jackson

Political Science 47.561 Development of Canadian External Relations

A seminar on the development of Canadian external relations since 1900.

Seminar three hours a week, fall term.

Prerequisites: Political Science 47.366 or permission of the instructor.

P. V. Lyon

Political Science 47.562 Issues in Canadian Foreign Policy

A seminar on selected issues.

Seminar three hours a week, winter term, day and evening divisions.

Prerequisites: Political Science 47.366 or permission of the instructor.

P. V. Lyon

Political Science 47.567 U.S. Foreign Policy Decision-Making

A seminar on the institutions and processes affecting U.S. foreign policy planning and decision-making.

Seminar three hours a week, fall term.

Prerequisites: Political Science 47.466 or permission of the instructor.

Not offered 1973-74

Political Science 47.571 Soviet-American Relations

A seminar on Soviet-American relations since the Second World War, including the role of ideology, the nature of the bipolar system and the emergence of the nuclear stalemate.

Seminar three hours a week, winter term, day and evening divisions.

Prerequisite: Permission of the instructor.

Instructor to be announced

Political Science 47.581 Foreign Policies of African States

A seminar on the comparative study of the foreign policy behavior of independent African states.

Seminar three hours a week, fall term.

Prerequisite: Permission of the instructor.

Not offered 1973-74

Political Science 47.582 International Politics of Africa

A seminar on the interactions of African states within the African subsystem and with other factors in the international system.

Seminar three hours a week, winter term.

Prerequisite: Permission of the instructor.

D. G. Anglin

Political Science 47.583 Foreign Policies of the Major Far Eastern Powers

The foreign policies of the Far Eastern powers, with special attention to China and Japan; an analysis of the domestic sources of policy, capabilities, interest, decision-making processes and foreign relations.

Seminar three hours a week, winter term.

Prerequisite: Permission of the instructor.

Not offered 1973-74

Political Science 47.585 Foreign Policy Analysis

A seminar dealing with selected problems in theory and research on foreign policy formulation and outcomes. Special attention will be given to the generation and utilization of data.

Prerequisite: Political Science 47.460, or permission of the instructor.

Seminar, three hours a week, fall term.

J. H. Sigler

Political Science 47.586 Military Strategy and Defence Policy

A seminar on the analysis of recent western as well as Soviet and Chinese strategic concepts; civilian-military relations; defence policy decision-making; arms control and disarmament and conflict resolving methods.

Seminar two and a half hours a week, fall and winter terms, day and evening divisions.

Prerequisite: Permission of the instructor.

Not offered 1973-74

Political Science 47.587 Problems in International Organization

A seminar on themes or problems in international organization, including both substantive and methodological questions. The themes will normally vary from year to year.

Seminar three hours a week, winter term.

Prerequisites: Political Science 47.360 or permission of the instructor.

B. W. Tomlin

Political Science 47.589 Advanced International Relations Theory

A seminar on selected topics and research methods in the theory of international politics, with special emphasis on the utilization and development of data.

Seminar three hours a week, winter term.

Prerequisites: Political Science 47.460 or permission of the instructor.

J. H. Sigler

Political Science 47.590 Tutorial in a Selected Field

Tutorials or reading courses on selected topics may be arranged with the permission of the Chairman of the Department and agreement of the instructor.

Tutorial, fall and winter terms.

Members of the Department

Political Science 47.591, 47.592, 47.593 Tutorial in a Selected Field

Tutorials or reading courses on selected topics may be arranged with the permission of the Chairman of the Department and agreement of the instructor.

591 fall term; 592 winter term; 593 spring term.

Members of the Department

Political Science 47.598 Research Essay

For students who write a research essay rather than a thesis.

Tutorial, fall and winter terms.

Political Science 47.599 M.A. Thesis

Political Science 47.690 Ph.D. Tutorial

A tutorial to prepare Ph.D. candidates for their comprehensive examinations under the direction of one or more members of the Department. Equivalent to two full-courses; the grade to be awarded will be that obtained on the comprehensive examination.

Tutorial, fall and winter terms.

Members of the Department

Political Science 47.699 Ph.D. Thesis

PSYCHOLOGY

Chairman of the Department: T. R. Ryan
Supervisor of Graduate Studies: To be announced

The Department offers opportunities for advanced studies and research in experimental psychology. Clinical and other applied programs are not available.

The Department of Psychology is located in the Loeb Building, a Social Science complex situated on the bank of the Rideau River. The Department's research facilities occupy approximately 13,000 square feet of space. The vivarium is ideally suited for the housing and maintenance of animals used in learning, motivation, and physiological-comparative studies. Adjacent laboratories are well equipped with solid state instruments, polygraphs and oscilloscopes for the monitoring, recording, and automatic programming of physiological and learning experiments, as well as an on-line PDP-8I computer interfaced with operant conditioning chambers and a PDP-8I for research in human learning and memory. Two laboratories located near the vivarium are designed and equipped for small animal surgery and histology. In addition to standard equipment used in human learning experiments, photographic apparatus for recording eye movements and six-channel tachistoscope are available.

Specially constructed observation rooms in which the behavior of both children and adults may be observed are available for studies in developmental and social psychology. These rooms are equipped with both auditory and visual instrumentation for use either in recording behavior of subjects or communicating with them. The Department also has a large anechoic chamber designed for auditory research, currently associated with the developmental psychology program.

A nursery school on the premises, directed by the Department, provides an excellent opportunity for studying the behavior of young children and serves as a valuable pool of experimental subjects. Small laboratories intended for student research are also available.

Candidates will be accepted for graduate studies in psychology only if they are prepared to register for full-time study. Part-time enrolment in the graduate program is permitted only when the amount of work involved in the completion of the thesis requirement does not justify classification as a full-time academic activity.

All graduate students in psychology are expected to conduct research of interest to them during each year of graduate studies, whether or not they are registered in a thesis course. This requirement may be satisfied in one of the following ways:

- Undertaking an independent research project.
- Serving as a research assistant to a staff member.
- Doing pilot research for a thesis.
- Being actively involved in thesis research.

Each term, the candidate's adviser will submit a written critique of research progress, along with a letter grade; these will become part of the candidate's

permanent record. Qualifying Year students will be evaluated at the end of the first 12 months. In addition to the research activity, candidates may be required to serve as teaching assistants.

Depending on the field of concentration, a candidate may be required to demonstrate to the satisfaction of his research supervisor, an ability to read with understanding relevant technical material in a foreign language and/or to give satisfactory evidence of competence in such areas as computer techniques, electronic instrumentation, psychometrics, sampling procedures, or surgical techniques.

The Department may recommend that a graduate student be asked to withdraw from the program at any time if his course and/or research performance is unsatisfactory.

All students are required to take a basic graduate course in quantitative methods (Psychology 49.545). However, students may elect to take a qualifying open-book examination prior to fall registration, which would encompass the material covered in Psychology 49.545. Successful completion of the examination will waive the above requirement.

QUALIFYING YEAR PROGRAM

Candidates with exceptional promise who have substantially less than the Honours B.A., may be admitted to a Qualifying Year program which is designed to prepare them for Master's study. A minimum grade of B− must be obtained in each Qualifying Year course in order to qualify for admission to the Master's program.

The Qualifying Year program may, in some instances, include half-courses in lieu of deficient full-course credits to satisfy a particular requirement if the undergraduate preparation is otherwise satisfactory. Candidates may be required to register in, and complete satisfactorily, a thesis comparable to that expected of Honours B.A. students.

The specific courses in the Qualifying Year program will be selected by the candidate in consultation with his adviser and members of the Department's Graduate Studies Committee.

MASTER OF ARTS

Admission Requirements

The normal requirement for admission into the Master's program is an Ontario Honours B.A. with second class standing (or its equivalent) with credit in the following areas:

Statistics and design of experiments.
Experimental psychology.
Learning or motivation.
Physiology and/or comparative psychology.
History and/or systems.
Two or three additional courses in psychology.

Candidates with particular course deficiencies may be required to register in additional courses at Carleton.

In addition, scores on the Graduate Record Examination (Aptitude and Advanced) are required at the time of application.

Program Requirements

The Master's program usually consists of three full-courses (or the equivalent), of which at least two must be at the graduate level (numbered 500 or higher), and a thesis (equivalent to two full-courses) which must be defended at an oral examination.

Academic Standing

A grade of B— or better is required in each of the 5 courses counted for credits towards the M.A. degree. One grade of C+ or C (but not C—) may be accepted on the recommendation of the Department.

DOCTOR OF PHILOSOPHY

Admission Requirements

The requirements for admission to doctoral programs are outlined in the general regulations section of this Calendar.

Applicants should note that of the B.A., M.A., and Ph.D. degrees in Psychology, only two may ordinarily be taken at Carleton University.

Program Requirements

The minimum program requirements for the Ph.D. degree in Psychology are as follows:

- A minimum of 10 full-course credits. A minimum grade of B must be obtained in each course.

- A thesis, equivalent to four or five of the required 10 full-course credits.

- A major area of specialization must be selected in which not less than 6 nor more than 7½ full-course credits (including the thesis) may be offered in fulfilment of the ten-course requirement.

Comprehensive Examinations

All Ph.D. candidates are required to pass written and oral examinations in their area of specialization. These examinations will consist of both content and design questions, and some choice among the questions will be permitted. The content questions will be selected from a list of previously published study questions, while the design portion of the examination will deal specifically with types of experimental designs which might be encountered in the student's area of specialization; no study questions will be provided for this section. The content portion of the examination will be closed-book, while the design section will be open-book.

The oral comprehensive examination will be undertaken not less than one week and not more than three weeks after the written section. The purpose of the oral is to give the student an opportunity to expand on the answers and solutions submitted in the written examination.

The comprehensive examinations are offered twice annually, in the Spring and in the Fall, and are ordinarily undertaken in the Spring of the first year of Ph.D. studies. The candidate must obtain a minimum grade of B− on both parts (content and design) of the examination.

GRADUATE COURSES

Through inter-university cooperation in graduate instruction, full-time graduate students registered in the Department of Psychology may enrol in one course at the University of Ottawa.

Psychology 49.500 Systems of Psychology

An examination of the cultural origins, the substance, and the fate of selected psychological systems and theories of the late 19th and early 20th centuries.

Seminar three hours a week, fall term.

M. E. Marshall

Not offered 1973-74

Psychology 49.501 Problems in the History of Psychology

A study of one or more selected topics in the history of man's attempt to understand his own nature.

Seminar three hours a week, fall term.

A. B. Laver

Psychology 49.510 Research Methods in Social Psychology I

Exposure to and experience with selected research and data analysis techniques of particular relevance for social psychology. Attention may be given to sampling design, data analysis, attitude scaling, varieties of measurement techniques, etc. Incoming students who will be writing a thesis in the area of social psychology normally will be required to offer standing in this course.

Seminar three hours a week, fall term.

J. C. Barefoot

Psychology 49.511 Research Methods in Social Psychology II

Consideration of current ethical and methodological issues in social psychological research. Attention may be given to the experimenter effects, consequences of deception, demand characteristics of experiments, effects of subject variables, etc. Incoming students who will be writing a thesis in the area of social psychology normally will be required to offer standing in this course.

Seminar three hours a week, winter term.

J. T. Partington

Psychology 49.523 Seminar in Physiological Psychology I

A detailed consideration of selected classical and contemporary issues in physiological psychology. Attention will be directed towards problems associated with the study of, and the foundations of current thought concerning, perceptual and motor processes. Incoming students who will be doing their thesis in the physiological area normally will be required to offer standing in this course.

Seminar three hours a week, fall term.

J. B. Kelly and B. A. Pappas

Psychology 49.524 Seminar in Physiological Psychology II

A detailed consideration of selected classical and contemporary issues in physiological psychology. Attention will be directed towards problems associated with the study of, and the foundations of current thought concerning, central processes such as motivation, emotion and learning. Incoming students who will be doing their thesis in the physiological area normally will be required to offer standing in this course.

Seminar three hours a week, winter term.

B. A. Pappas and J. B. Kelly

Psychology 49.545 Quantitative Psychology

A problem-oriented approach will be taken in discussing graphic methods, statistical estimation, correlation techniques, regression analysis, chi-square, and other selected non-parametric techniques, and analysis of variance. Computer techniques will be integrated with the course content when appropriate, with emphasis upon the fact that the computer does the computations, but interpretation remains the responsibility of the psychologist. This is a two term course.

Seminar and lectures three hours a week, fall and winter terms.

Jo Tombaugh

Psychology 49.551 Theories of Child Development

Diverse major, theoretical positions will be presented and evaluated in terms of research findings. (See also Sociology 53.551)

Seminar three hours a week, fall term.

T. J. Ryan

Psychology 49.552 The Psychology of Early Childhood

Behavioral development during the early stages in acculturation. Topics will include sensory and perceptual processes, motor development, learning, cognitive, social and emotional development.

Seminar three hours a week, winter term.

W. Croll

Psychology 49.561 Contemporary Research in Personality

Current controversial issues in personality research and selected research studies in personality development and theory.

Seminar three hours a week, winter term.

Not offered 1973-74

Psychology 49.570 Research Methods in Learning

Experimental methods, research design and instrumentation in the fields of learning and retention. Special emphasis will be given to response definition and measurement, procedures and equipment for monitoring and recording the learning process, instructions, and problems of control.

Seminar three hours a week, fall term.

M. Marshall and others

Psychology 49.573 Human Learning

A discussion of selected topics within the area of human learning.

Seminar three hours a week, winter term.

P. D. McCormack and others

Psychology 49.575 Behaviour Modification I

The basic principles of learning as they apply to the modification of behaviour will be examined. Emphasis will be placed on application, ethics, research and methodology.

Seminar three hours a week, fall term.

T. N. Tombaugh

Not offered 1973-74

Psychology 49.576 Behaviour Modification II

Specific problems and topics related to behaviour modifications will be discussed. A major paper and project will be required.

Seminar three hours a week, winter term.

Prerequisite: 49.575

T. N. Tombaugh

Not offered 1973-74

Psychology 49.590, 592, 594 Directed Studies

Students may register in this course only under special circumstances. An investigation in depth of selected problems in psychology by means of directed library research. The student will be expected to obtain approval for the topic of his choice from the Graduate Committee and to present for discussion and evaluation a series of papers on matters relevant to the agreed-on problem. One copy of the report must be filed in the Departmental Office.

590 fall term; 592 winter term; 594 spring term.

Members of the Department

Psychology 49.591, 593, 595 Independent Research

Permission to register and approval of research plan must be obtained from the Graduate Committee. This course may be repeated for credit. A report describing all aspects of the completed research is required. This report will be prepared as if it were being submitted to a journal for publication. One copy of the report must be filed in the Departmental Office.

591 fall term; 593 winter term; 595 spring term.

Members of the Department

Psychology 49.599 M.A. Thesis
Members of the Department

Psychology 49.610 Research Seminar in Social Psychology I
Seminar three hours a week, fall term.
N. Donald

Psychology 49.611 Research Seminar in Social Psychology II
Seminar three hours a week, winter term.
Not offered 1973-74

Psychology 49.620 Research Seminar in Physiological Psychology I
Seminar three hours a week, fall term.
D. C. McIntyre

Psychology 49.621 Research Seminar in Physiological Psychology II
Seminar three hours a week, winter term.
Not offered 1973-74

Psychology 49.626 Comparative Psychology
Varied and acquired adaptive mechanisms and their phylogenesis. Topics
will include: attachment behavior, social organization, learning abilities,
communication and motivation.
Seminar three hours a week, fall term.
Not offered 1973-74

Psychology 49.650 Research Seminar in Developmental Psychology I
Seminar three hours a week, fall term.
Not offered 1973-74

Psychology 49.651 Research Seminar in Developmental Psychology II
Seminar three hours a week, winter term.
Members of the Department

Psychology 49.670, 671 Research Seminar in Learning
Seminar three hours a week, 670 fall term; 671 winter term.
Members of the Department

Psychology 49.675 Teaching Techniques in Psychology
Designed for persons pursuing a career in academic psychology. Literature
on teaching effectiveness will be examined and the students will be given
experience in the preparation of classes and courses planning.
Seminar three hours a week, winter term.
Instructor to be announced

Psychology 49.690, 692, 694 Directed Studies

Students may register in this course only under special circumstances. An investigation in depth of selected problems in psychology by means of directed library research. The student will be expected to obtain approval for the topic of his choice from the Graduate Committee and to present for discussion and evaluation a series of papers on matters relevant to the agreed-on problem. One copy of the report must be filed in the Departmental Office.

Seminar three hours a week: 690 fall term; 692 winter term; 694 spring term.

Members of the Department

Psychology 49.691, 693, 695 Independent Research

Permission to register and approval of research plan must be obtained from the Graduate Committee. This course may be repeated for credit. A report describing all aspects of the completed research is required. This report will be prepared as if it were being submitted to a journal for publication. One copy of the report must be filed in the Departmental Office.

691 fall term; 693 winter term; 695 spring term.

Members of the Department

Psychology 49.699 Ph.D. Thesis

Members of the Department

PUBLIC ADMINISTRATION

Director of the School: G. B. Doern

PUBLIC ADMINISTRATION

The School of Public Administration was established in 1953 through the assistance of a generous grant from the Atkinson Charitable Foundation.

The School offers two separate graduate programs of study and research in the field of administration. Prospective applicants are urged to evaluate carefully these two opportunities in order that they may select the one most suitable to their interests, background, and academic qualifications.

- *Diploma in Public Administration* (D.P.A.) — a program designed to offer those persons in (or planning to enter) administrative careers an opportunity to begin acquiring some introductory exposure to subject matter related to administrative studies. This Diploma program, which consists of five full-courses or the equivalent, is more fully described below.

- *Master of Arts* — a program designed to provide a balanced exposure to both administrative studies and to public sector-private sector decision-making processes. The M.A. program is more fully described on the following pages.

Inquiries and requests for further information may be directed to the School. In particular, the programs of currently active students may require some adjustment in 1973-74 as a transitional measure.

GRADUATE DIPLOMA IN PUBLIC ADMINISTRATION

The Diploma in Public Administration is designed to offer those persons in, or planning to enter, administrative careers an opportunity to begin acquiring some introductory exposure to subject matter related to administrative studies. The program consists of five courses and may be taken on a part-time or full-time basis.

The program is based on the recognition that persons with widely varying backgrounds will enter the program. Students who successfully complete the D.P.A. program may apply for admission to the M.A. program, at which time they will be considered for admission along with all other applicants. If all of the Qualifying Year courses (see p. 130) are not taken as part of the D.P.A., they will be required in addition to the final year M.A. courses.

Admission Requirements

To be considered for admission, an applicant must have a Bachelor's degree with at least second class standing from a recognized university, and must have completed courses in Introductory Economics (Economics 100 or 101, or the equivalent), in Canadian Government and Politics (Political Science 200 or the equivalent) and in Public Administration (Political Science 47.340 or the equivalent).

Program Requirements

The program consists of five full-course credits, at least four of which must be completed at Carleton. Advanced standing may be granted in one full-course (or equivalent) if previous work is judged to be equivalent to courses required in the program. A student who has taken one (or more) of the other required courses prior to admission, must substitute another course (or courses) in consultation with the Director. In the event that a part-time student is required by his employer to move away from Ottawa, he may apply to complete *one* full-course or the equivalent at another university provided that no transfer of credit was granted on admission.

Students are required to complete the following program:

- Administration 50.410   Management Accounting *AND*
  Administration 50.411   Financial Management
- Administration 50.420   Economics for Management and Policy I *AND*
  Administration 50.421   Economics for Management and Policy II

  OR one of:

  Economics 43.335   Political Economy in the Modern State
  Administration 50.565   Government — Industry Policy Relations
- Administration 50.430   Organizational Behaviour
- Administration 50.435   Law of Public Authorities
- Administration 50.450   Quantitative Methods I *OR* an approved option

Part-time students already admitted to the D.P.A. program under the provisions of previous Calendars may adjust their programs to take advantage of the revised program outlined above.

Academic Standing

All candidates are required to obtain a grade of B— or better in each course in the program. A candidate may, with the recommendation of the School and the approval of the Faculty of Graduate Studies, be allowed a grade of C+ or C (but not C—) in one full-course or each of two half-courses.

MASTER OF ARTS

The Master's program is specifically designed to provide the prospective *and* the mid-career administrator with a balanced exposure to administrative studies and to public and private sector policy relations. Through this public sector-private sector emphasis the School hopes to provide students with an opportunity to develop their problem-solving abilities and presentation of policy alternatives and strategies, regardless of the nature or location of the organization in which they work.

The contemporary manager or administrator is increasingly required to be both a policy adviser and formulator and to have a substantive understanding of the many disciplines and variables associated with the decision-making process in contemporary organizations. University programs can begin to provide some of the foundations that will enable persons to acquire an understanding of the broad financial, legal, economic, political and social interrelationships that affect decisions in any organization.

The academic staff and the students in the School reflect a broad cross-section of disciplines and backgrounds. This is an important feature of the opportunities available inasmuch as the programs are not designed to train experts in such particular disciplines as financial management, economics, political science, psychology or law, but to expose students with varying backgrounds to a basic understanding of the contribution of these disciplines.

The School of Public Administration, because of its location in Ottawa, is able to provide the student with a unique exposure to the resources and personnel located in the national capital. The study of *public sector-private sector* relationships can be pursued with a total range of resources not as readily available in other locations.

All part-time students already admitted to the Master's program on the basis of previous Calendar requirements may continue their part-time program according to the terms of their current Statement of Standing on Admission. Students should contact the Director of the School if they are in doubt as to their status or their remaining program requirements.

Admission Requirements

To be considered for admission to the Qualifying year program, an applicant must have a Bachelor's degree or equivalent with at least second class standing from a recognized university, and must have already completed courses in Introductory Economics (Economics 43.100 or 43.101 or equivalent), Canadian Government (Political Science 47.200 or equivalent), and Public Administration (Political Science 47.340 or equivalent).

Applicants without advanced standing will ordinarily be considered for admission to the Qualifying Year Program. In all such cases eligibility for admission to the Master's program will be dependent on the achievement of adequate standing in the work of the Qualifying Year Program.

The School's admission policy will, of course, be governed by the availability of graduate student spaces and the need to admit applicants from a variety of disciplines and backgrounds (e.g. social sciences, humanities, law, engineering, science). Possession of the minimum admission requirements does not, in itself, guarantee acceptance.

Advanced standing may be granted if previous work is judged to be equivalent to courses required in the program. Advanced

standing and transfer of credit must be determined on an individual basis in consultation with the Director, and must also be approved at the time of *admission* by the Dean of the Faculty of Graduate Studies.

Program Requirements

It must be fully understood that the program of studies leading to eligibility for admission to the M.A. program normally consists of five full-courses (or the equivalent), which comprise the *Qualifying Year Program.*

All candidates must also provide evidence of a basic understanding of computing science (either by registering in Computer Science 95.101 or by passing a test arranged by the School).

The M.A. program comprises five full-courses (or the equivalent) as described in a subsequent section of this Calendar.

QUALIFYING YEAR PROGRAM

The Qualifying Year Program is an *administrative studies* component consisting of the following courses:

Administration **50.435** Law of Public Authorities
50.410 Management Accounting
50.411 Financial Management
50.420 Economics for Management and Policy I
50.421 Economics for Management and Policy II
50.430 Organizational Behaviour
50.450 Quantitative Methods I

Students who successfully complete the Qualifying Year program with the required standing may be awarded the Diploma in Public Administration, provided that four full-courses have been taken at Carleton University.

MASTER OF ARTS PROGRAM

The Master's program consists of Administration 50.560 (Public Sector and Private Sector Planning and Policy Relationships) and four other full-courses or the equivalent selected in consultation with the Director from the following groups of options:

1. Public Policy and Administration

Administration 50.570, 50.571, 50.572 Policy Seminar
Administration 50.513 Public Sector Budgeting and Finance
Administration 50.501 Policy and Administration in Intergovernmental Relations
Political Science 47.401 Policy Making in Canada
Geography 45.505 Problems in Canadian Resource Development
Geography 45.506 Problems in Canadian Resource Development

Law 51.324 Tax Law and Policy

Law 51.555 Law of Public Authorities II

Political Science 46.544 Public Administration in Developed Western Countries

Political Science 47.540 Problems in Canadian Public Admin-, istration

2. **Government-Industry Policy Relations**

Administration 50.565 Government-Industry Policy Relations

Administration 50.572, 573 Policy Seminar

Administration 50.566 Science and Technology Policies

Sociology 53.592 Sociology of Science and Technology

International Affairs 46.530 The International Enterprise

Economics 43.410 Finance and Capital Markets

Economics 43.430 Industrial Organization and Public Policy

3. **Staffing and Personnel Management**

Administration 50.581 Staffing and Personnel Management

Administration 50.582 Public Sector Collective Bargaining

Administration 50.583 Problems in Organizational Change and Development

Sociology 53.526 Sociology of Occupations and Professions

Law 51.445 Staff Relations in the Public Service

Economics 43.465 Industrial Relations

Law 51.441 Labour Law

4. **Urban Policy and Intergovernmental Relations**

Administration 50.501 Policy and Administration in Intergovernmental Relations

Economics 43.580 Urban Economics

Political Science 47.409 French Canadian Politics

Political Science 47.500 Problems of Canadian Local Government and Politics

Political Science 47.501 Problems of Canadian Provincial Government and Politics

Political Science 47.502 Comparative Local Government

Law 51.474 Local Government Law

Geography 45.445 Land Resource Use

Economics 43.440 Public Finance

Political Science 47.405 Federalism

5. **International and Comparative Development and Administration**

Political Science 47.544 Public Administration in Developed Western Countries

Political Science **47.545** Public Administration in Developing Countries

Political Science **47.561** Development of Canadian External Relations

Political Science **47.562** Issues in Canadian Foreign Policy

Political Science **47.587** Problems in International Organization

International Affairs 46.500 International Integration

International Affairs 46.505 Political and Economic Development

International Affairs 46.530 The International Enterprise

Law 51.461 International Economic Law

Economics 43.460 International Trade

Geography 45.580 Problems of Asian Development

Geography 45.530 Problems of African Development

GRADUATE COURSES

Qualifying Year Program (*Administrative Studies Component*)

Administration 50.410 Management Accounting

An introduction to the underlying assumptions and basic principles of accounting and an examination of the uses of accounting information by management. Topics include income measurement, asset valuation, financial statement analysis, cost systems, control reports, operating budgets, capital expenditure decisions, and alternative choice problems.

Seminar, three hours a week, fall term.

J. B. Waugh

Administration 50.411 Financial Management

An examination of the principles and practice of financial planning and control. Analysis of the problems of resource allocation and asset management under conditions of uncertainty. Techniques of capital expenditure analysis, and analysis of funds flow.

Prerequisite: Administration 50.410 or permission of the Instructor.

Seminar, three hours a week, winter term.

Lecturer to be announced

Administration 50.420 Economics for Management and Policy I

An examination of the concepts and uses of micro-economic theory and methods in organizational resource allocation.

Seminar, three hours a week, fall term.

W. Hettich

Administration 50.421   Economics for Management
and Policy II

An examination of the concepts and uses of macro-economic theory and methods in total science resource allocation, including fiscal and monetary policy.

Seminar, three hours a week, winter term.

K. Acheson

Administration 50.430   Organizational Behaviour

An examination, using behavioural science concepts, of the interaction between individuals, groups and the total organization, including the topics of authority, power, socialization, conflict and motivation. The course will draw on literature from both public and private sector organizations.

Seminar, three hours a week, fall and winter terms.

D. Swartz

Administration 50.435   Law of Public Authorities

An examination of the processes essential to translate public policy into effective legislation, and of the basic legal problems faced by managers in either implementing or being responsive to legislated policy. Topics include the development of a social plan, articulation of government policy in statutory form, sanctions, statutory drafting, the choice of forum for decision-making and interpretation, discretionary justice, and judicial control of public authorities.

Also listed as Law 51.455

Lectures and seminars, three hours a week, fall and winter terms, day and evening divisions.

I. Hunter

Administration 50.450   Quantitative Methods I

An introduction to the theory of measurement and various methods of data collection and causal analysis. Emphasis will be put on public opinion survey research, content analysis, personnel evaluation and policy analysis. Under the guidance of the instructors, students are expected to devise their own research designs, and analyze empirical data with the use of the computer.

Lectures and discussion, three hours a week, fall and winter terms.

Lecturer to be announced

(Public Sector — Private Sector Component)

Administration 50.501   Policy and Administration in
Intergovernmental Relations

An examination of the policy and administrative relations among the federal, provincial and urban governments in Canada. The course will explore selected substantive policy and program areas, including tax policy, social security and social welfare policies, health care, and economic development programs.

Seminar, three hours a week, fall and winter terms. In 1973-74 the seminar will focus on Health Care policy.

I. MacDonald and P. Aucoin

Administration 50.513   Public Sector Budgeting and Finance

An examination of the budgeting, accounting, and financial management problems associated with systems design and implementation for public sector organizations.

Seminars, three hours a week, fall and winter terms.

Administration 50.560   Public Sector — Private Sector Planning
and Policy Relationships

An examination of policy relations between government and the private sector (with emphasis on corporations and labour unions).

Seminars and lectures, three hours a week, fall and winter terms.

I. MacDonald

Administration 50.565   Government-Industry Policy Relations

An examination of the main policies, programs and strategies of those government departments (federal and provincial) which have the most direct interface with the industrial and corporate sector in Canada. These departments include Industry, Trade and Commerce, Treasury and Economics, Consumer and Corporate Affairs, etc.

Seminars, three hours a week, fall and winter terms, evening division.

G. B. Doern

Administration 50.566   Science and Technology Policies

An examination of Canadian programs, policies and strategies toward the development of scientific and technological capability and towards the use of science and technology in social and economic programs.

Seminars, three hours a week, spring, 1974 term, evening division.

G. B. Doern

Administration 50.570 Policy Seminar

An examination of one or more selected policy areas. The focus will be an analytical assessment of the selected policy field in terms of its many-sided economic, political, social, legal, quantitative and administrative complexities.

Seminars, three hours a week, fall and winter terms.

Not offered 1973-74

Administration 50.571 Policy Seminar

An examination of one or more selected policy areas. The focus will be an analytical assessment of the selected policy field in terms of its many-sided economic, political, social, legal, quantitative and administrative complexities. In 1973 the topic will be federal and provincial industrial incentive programs.

Seminars, three hours a week, spring term.

I. MacDonald

Administration 50.572, 50.573 Policy Seminar

An examination of one or more selected policy areas. The focus will be an analytical assessment of the selected policy area in terms of its many-sided economic, political, social, legal, quantitative and administrative complexities. The policy field will change each year. 1973-74 topics: 572: Social Policy. 573: Industrial Democracy.

Seminars, three hours a week, 50.572 fall term; 50.573 winter term.

572. Instructor to be announced

573. D. Swartz

Administration 50.581 Staffing and Personnel Management

An examination of the staffing and personnel management functions in large public and private organizations, including recruitment, selection, and performance appraisal, reward systems, and the roles of staffing professionals.

Seminar, three hours a week, fall term, day and evening divisions.

Administration 50.582 Public Sector Collective Bargaining

An examination of the concepts, structures and processes of collective bargaining in the public sector in Canada.

Seminar, three hours a week, winter term, day and evening divisions.

Administration 50.583   Problems in Organizational Change and Development

An examination, through case work and group projects, of the concepts and issues of planned organizational changes.

Seminar, three hours a week, winter term, day and evening divisions.

Not offered 1973-74

Administration 50.591, 592, 593   Directed Studies

A tutorial or directed reading course on selected subjects. 591 fall term, 592 winter term, 593 spring term.

Members of the faculty

Administration 50.598   Research Essay

Fall and winter terms, and spring term.

Members of the faculty

Administration 50.599   M.A. Thesis

Fall and winter terms, and spring term.

Members of the faculty

SOCIAL WORK

Director of the School: S. James Albert

The School of Social Work of Carleton University offers a two-year program leading to the degree of Master of Social Work.

The social work profession seeks to promote the conditions and opportunities under which people may more effectively function in their relationships with one another, as individuals, as members of families, of groups, and of the community, and to help with such problems as arise from limitations in social functioning. This it seeks to accomplish both by promoting and influencing institutional and societal change, and by helping individuals, families, and groups meet personal social problems.

With these objectives, the profession of social work is widely involved in both the social welfare and mental health fields. Social workers are employed by and work with many community programs and organizations, such as family and child welfare agencies, psychiatric and general hospitals, public welfare departments, community centres, and social planning councils.

THE ACADEMIC YEAR (SCHOOL OF SOCIAL WORK)

The School of Social Work divides its academic year in a different manner than that employed by the rest of the university. All candidates are required to complete, on a full-time basis, the six sessions that comprise the School's two-year program. The curriculum is organized in the following way:

First Year Students

FALL SESSION 1973

Registration	Wednesday, Sept. 12
Classes begin	Monday, Sept. 17
Classes end	Friday, Dec. 14

WINTER SESSION 1974

Practice Instruction begins	Monday, Jan. 7
Practice Instruction ends	Friday, May 3

SPRING SESSION 1974

Classes begin	Monday, May 13
Classes end	Friday, June 28

In the first year, students will devote the fall and spring sessions to studies on campus, and the winter session to field practice instruction. New registrants commence their work with the fall session.

FALL-WINTER SESSIONS 1973-74

    Practice Instruction begins . . . . Monday, Sept. 10

    Practice Instruction ends . . . . Friday, Feb. 22

SPRING SESSION 1974

    Classes begin . . . . Monday, March 4

    Classes end . . . . Friday, May 17

In the second year, the fall-winter sessions are devoted to practice instruction, and the spring session to study on campus.

Enquiries and applications should be addressed to the Admissions Office at the School. Application for admission, on the form supplied by the School, should be made as early as possible (December or January) in order that the Admissions Committee may have ample time for full and careful processing of the application. First-year students are admitted only at the beginning of the fall session. Applicants to the second-year program on transfer from another school must make application prior to January 1. Their program begins with the spring session.

MASTER OF SOCIAL WORK

Admission Requirements

Admission to the School is on a selective basis and will be assessed in relation to three general criteria. The minimum requirements for admission are:

(i) Graduation from a recognized college or university with a Bachelor's degree, preferably of the Liberal Arts type, with emphasis on the Social Sciences. A "B" standing at the undergraduate level is expected of candidates for admission.

(ii) An applicant must present evidence of being in good health.

(iii) The candidate's personal suitability for the Carleton program and the profession. References and other application material will be critical in this regard.

Program Requirements

The specific program requirements of the School of Social Work are the following:

- Three academic sessions
- Two field practice sessions
- Specified research requirements

The Social Work program at Carleton University is undergoing some re-orientation. It has traditionally placed strong emphasis on "Social Work Treatment," those clinical methods of effecting change by means of individual, family, and group pro-

cesses, and this is to be maintained. Increasing emphasis, however, is now being placed on administrative and policy-making processes, and on the analysis of welfare programs and policy issues. A new emphasis on community organization and development has been introduced into the School's program.

The program includes the following major curriculum segments:

• A knowledge of the interactional process of the human person and his social environment — Human Behavior and Social Environment;

• Understanding of the method and process of social work intervention with individuals, families, and groups utilizing the disciplined and purposive use of one's self — Social Work Treatment;

• Understanding of the social policy process as it particularly relates to social work participation in it — Social Welfare Policy;

• Understanding community structures and dynamics and the place of social work in community settings — Community Organization and Development;

• Knowledge relevant to the application of research processes pertinent to social work, and to the development of capacity for critical and disciplined analysis of social work problems to be achieved through an emphasis on current research in most courses, and through an independent faculty-directed research project — Research Process;

• Skill in the use of social work knowledge as developed through the social work practice sequence.

Carleton University employs the "Block Plan" system for practice instruction, a carefully designed sequence of academic work and practice instruction. The School makes use of placement facilities in Eastern Canada, and a limited number of students are placed in the Social Service Centre of Carleton University, a practice instruction centre operated by the School of Social Work. The majority of first session placements are in the Ottawa region.

The Master's program requirements are normally completed in two years, and must be completed within a maximum of five years to obtain the degree.

Academic Standing

A student in the first year may obtain not more than two grades of C or C+ (except in field practice where a B passing grade is required) and must have at least an overall B— average to be eligible for promotion.

A grade of B must be obtained in each course taken during the final year.

BUDGETARY INFORMATION

An annual budget covering tuition, living expenses, travel to and from the field practice locale, books, etc., is estimated to require approximately $3,000. Second-year expenses, are about one-fifth lower than in the first year, except that research expenses, including typing, must be added.

FINANCIAL ASSISTANCE

Students in the School of Social Work are also eligible to apply for support through the Canada Student Loans plan or the Ontario Student Awards Program.

A limited number of bursaries are available to second-year students who commit themselves to entering employment in approved welfare programs. These bursaries are administered and partly financed by the various provinces, and enquiries should be directed to the Deputy Minister, Department of Public Welfare (or Department of Social Welfare), in the provincial capital.

A student who experiences unexpected financial need in a term may apply for a graduate bursary of up to $200 for that term. Further information may be obtained from the Graduate Studies Office.

GRADUATE COURSES

One unit represents four hours of class work per week. All fall session courses must be taken. Second year courses are planned under faculty direction during the second practice placement.

Social Work 52.500 Human Behaviour and Social Environment
An exploration of the emergence of patterns of psychological functioning.
Four hours a week, fall session.

Social Work 52.503 Selected Topics in Family Functioning
Study of the factors that contribute to satisfactory family functioning or which may result in breakdown or dysfunction within the family, with particular reference to marital and parent-child interactions.
Two hours a week, spring session.

Social Work 52.504 Selected Topics in Individual Functioning
Study of the factors related to selected examples of problem behaviour.
Two hours a week, spring session.

Social Work 52.505 Selected Topics in Group Processes
Explorations of the major phenomena and process operative in small groups which have particular pertinence to the use of formed groups in social work practice.
Two hours a week, spring session.

Social Work 52.510 Social Welfare Policy

The development of social welfare policy and programs in the urban community and their translation into provisions for social welfare, as these are conditioned by ideological, social, and economic factors.

Four hours a week, fall session.

Social Work 52.513 Selected Topics in Social Welfare Policy

Analyses of social welfare policy planning process within organizations and at the community and interorganizational level; examination of the role of the professional social worker in the policy process.

Two hours a week, spring session.

Social Work 52.515 Selected Topics in Social Welfare Policy

A continuation of the analyses of social welfare planning involving participation of students in a community social welfare policy or program planning project.

Four hours a week, spring session.

Social Work 52.520 Basic Concepts in Social Work Methodology

An exploration of the conceptual foundations of social work methods.

Two hours a week, fall session.

Social Work 52.521 Social Work Treatment

Identification of "Social Work Treatment" within the broad spectrum of societal — institutional and individual — family change, such loci of change perceived and addressed as a gestalt. Conceptual examination of the elements of the enabling process with its bases in ego psychology and role and systems theories.

Four hours a week, fall session.

Social Work 52.523 Selected Topics in Social Work Treatment

A more complex determination of the role of the practitioner in relation to different size systems, identifying the generic and specific in the individual, family unit, and constructed group modes. Ego psychology and systems theory continue to constitute the base for examining the process of change.

Two hours a week, spring session.

Social Work 52.525 Selected Topics in Social Work Treatment

A critical and comparative study of current methodologies of social work and related practices within a broad conceptual framework, having as its theme throughout the dynamics of growth-change in the client and transactional systems, and the role and function of the practitioner in such processes. This course will be sub-divided into various specialties.

Four to eight hours a week, spring session.

Social Work 52.530 Research Planning

The basic processes of the research perspective: students work under faculty direction in locating and defining a research problem; types and sources of data; research instruments; steps in data analysis and reporting. Students should conclude with ideas for exploring the development of their independent project.

Two hours a week, fall session.

Social Work 52.533 Research in Social Work I

Identification, specification and design of an independent research project under faculty direction.

Four hours a week, spring session.

Social Work 52.534 Research in Social Work II

During this session the students complete the projects which were approved by the instructors during the laboratory sessions in the course Social Work 52.533.

One unit, fall and winter sessions.

Social Work 52.535 Research in Social Work III

Research methodology and selected research findings are used in the examination of different social work delivery systems and methods.

Two hours a week, spring session.

Social Work 52.536 Community Organization and Development

Various theories, principles and practices of social intervention related to social change in communities.

Four hours a week, fall session.

Social Work 52.542 Social Work Practice I

Seventeen weeks of full-time practice instruction, during the first year, in a selected practice situation.

Winter session.

Social Work 52.543 Social Work Practice Ia

An integrative analysis of an aspect of the practice experience requiring preparation by the student of a major essay, relating and integrating course content from other curriculum areas with social work practice.

Winter session.

Social Work 52.544 Social Work Practice II

Twenty-two weeks of full-time practice instruction, during the second year, in a selected practice situation.

Fall-winter sessions.

Social Work 52.554 Social Work Seminar

Planned individual studies and discussions or faculty-guided seminars designed to enable the student to deepen knowledge in a selected area.

Two hours a week, spring session.

SOCIOLOGY

Chairman of the Department: M. Frumhartz
Supervisor of Graduate Studies: J. Harp

The Department of Sociology offers programs of advanced study and research leading to the M.A. and Ph.D. degrees.

The principal focus of departmental interest at the graduate level is *Comparative Social Organization,* with complementary specialization in the study of *Social Demography-Ecology* and *Theory-Methodology.* The current activity of the members of the department is as follows:

- **Comparative Social Organization**
  Comparative Societies
  > R. Crook, J. Harp, B. McFarlane,
  > J. Porter, A. Steeves

  Comparative Institutions
  > C. Farmer, D. Forcese, M. Frumhartz, J. Harp,
  > K. Hatt, G. Irving, J. Porter, S. Richer,
  > J. Vantour, D. Whyte

  Occupations and Formal Organizations
  > C. Gordon, P. Hughes, B. McFarlane,
  > A. Steeves, V. Valentine

  Social Stratification and Mobility
  > D. Forcese, K. Hatt, J. Porter, A. Steeves

  Social Anthropology
  > C. Ackerman, J. Cove, B. Cox, H. Feit, S. Jones,
  > J. Manyoni, I. Prattis, J-F. Saucier, D. Smith,
  > V. Valentine, F. Vallee

- **Social Demography-Ecology**
  > M. Boyd, K. Mozersky, I. Pool, L. Stone, J. deVries,
  > G. Zubrzycki

- **Theory-Methodology**
  > C. Ackerman, H. Burshtyn, R. Crook, D. Forcese,
  > B. Johnson, Z. Jordan, G. Neuwirth, T. Nosanchuk,
  > J. deVries, C. Wells, D. Whyte

The Department of Sociology and Anthropology is located in the Loeb Building, a Social Science complex situated on the bank of the Rideau River. The Department's research and office facilities (including a small-groups laboratory) occupy approximately 13,000 square feet. The Department has access to the Canadian Institute of Public Opinion poll data and the Human Relations Area Files, and is a member, in co-operation with other social science departments, of the Inter-university Consortium for Political Research. Because of the location in Ottawa of Statistics Canada, the National Museum, the National Library, the National Science Library, the Archives and the headquarters of every government department (each with its own library), Ottawa is an excellent base of operations for socio-

logical research. The Social Science Reading Room, a reading room containing major social science periodicals and a limited holding of books, is located on the second floor of the Loeb Building. Access to electronic data processing equipment is available to researchers on the campus. Calculators and adding machines for graduate students' use are available in the Department.

QUALIFYING YEAR PROGRAM

Applicants with general (pass) Bachelor's degrees may be admitted to a Qualifying Year program designed to raise their standing to Honours status.

Refer to the general section of this Calendar for details of the regulations governing the Qualifying Year.

MASTER OF ARTS

Admission Requirements

The normal requirements for admission into the Master's program is an Honours B.A. (or the equivalent) with at least second-class standing.

Refer to the general section of this Calendar for details of the regulations governing admissions.

Program Requirements

Master's students in the Department of Sociology and Anthropology are required to select and follow one of the following optional program patterns:

- Three full-courses (or the equivalent); a thesis equivalent to two full-courses; and an oral examination on the program and thesis. Under certain circumstances two of the courses may be selected from those offered at the senior undergraduate level.
- Five full-courses (or the equivalent); written and oral examinations on the area of specialization; and an oral examination on the program. Under certain circumstances two of the courses may be selected from those offered at the senior undergraduate level.

Academic Standing

A grade of B— or better must normally be obtained in each course counted toward the Master's degree. With the recommendation of the Department, a candidate may be allowed a grade of C (but not C—) in one full-course or each of two half-courses.

DOCTOR OF PHILOSOPHY

The substantive focus of the Ph.D. program is the organization and development of modern societies, both in a comparative context and with particular reference to Canadian society.

Admission Requirements

The minimum requirement for admission to the Ph.D. program is a Master's degree (or the equivalent) in Sociology, with a minimum average of B+ in courses (including the thesis), and with no grade below B−.

Applicants are also required to submit results of the verbal, quantitative, and substantive Graduate Record Examinations.

Applicants who have deficiencies in certain areas may be admitted to the Ph.D. program, but will normally be required to complete additional course work.

Program Requirements

The specific program requirements of the Department of Sociology and Anthropology are the following:

- Ten full-courses (or the equivalent), including a thesis equivalent to a maximum of seven full-courses or a minimum of five full-courses.
- Written comprehensive examinations in three areas of specialization.
- An oral examination on the subject of the thesis and fields related to the Ph.D. program.

Comprehensive Examinations

Each Ph.D. candidate is required to write a total of three comprehensive examinations selected from the following areas:

- Comparative Social Organization
  - **Comparative Societies**
  - **Comparative Institutions**
  - **Occupations and Formal Organizations**
  - **Social Stratification and Mobility**
  - **Social Anthropology**
- Social Demography-Ecology
- Theory-Methodology

At least one (but not all) of the three examinations will be undertaken in a sub-area of Comparative Social Organization.

An approved field in a related discipline may be substituted for one of the areas listed above.

The comprehensive examinations are normally undertaken after completion of at least one year of Ph.D. study, and must be successfully completed at least one term before the oral defence of the thesis.

Language Requirement

The Department of Sociology and Anthropology requires each Ph.D. candidate to demonstrate an understanding of a language other than French. Although French is the preferred

second language, students may be permitted to substitute another language if it is demonstrably more relevant to their professional interests. It is strongly advised, however, that all English-speaking candidates be proficient in French. This requirement may be satisfied in two steps.

- Show standing of C— or better in a full-course at the introductory level, offered at Carleton (or the equivalent) in a language other than English, appropriate to the candidate's area of professional interest and;
- Demonstrate reasonable understanding, on sight, of material contained in selected samples of the sociological literature in that language.

Academic Standing

Candidates must obtain a grade of B— or better in each course and on the comprehensive examinations.

GRADUATE COURSES

Sociology 53.500 Seminar in Traditional Theory: Theories of Social Interaction and Social Group Formation

An examination of sociological theories, especially those concerning social contract, the social organism, social solidarity, social interaction, and community, as reflected in portions of the works of, for example, David Hume, Adam Smith, Adam Ferguson, Herbert Spencer, Karl Marx, Georg Simmel, Ferdinand Toennies, and Emile Durkheim. The emphasis in this seminar will be on how the treatment of these issues by the scholars mentioned bear on continuing issues and debates in social theory.

Seminar two hours a week, fall term.

D. Smith

(The seminar on Marx and Simmel, ordinarily given as 53.500, will be offered by Z. Jordan in 1974-75.)

Sociology 53.501 Seminar in Traditional Theory: Durkheim and Weber

Durkheim: The social division of labor and social evolution; methodological holism and positivistic definition of social phenomena; psychology and sociology; facts, values and the science of morals; the sociology of knowledge. Weber: Natural and cultural sciences; Max Weber as the founder of social action theory; the nature and the role of values in social inquiry; the theory of ideal type and its place in contemporary typology; the application of ideal type construction; the concept of rationality (the effects of technological advancement, the increasing complexity of formal organization, secularization and the social isolation of man in society).

Z. A. Jordan

Not offered 1973-74

Sociology 53.502 Contemporary Theory: Social Behaviourism

Experimental research in sociology primarily utilizing exchange theory. The logical adequacy, the quality of the empirical evidence, and the range of applicability of the model will be evaluated.

Seminar two hours a week, winter term.

D. Forcese

Sociology 53.503 Contemporary Theory: Theories of Social Action

The problem of conceptualizing social action as part of on-going everyday activity and as an aspect of sociological theorizing will be examined. The basis of common-sense understandings of social action, the development of limited-range analytical models, and the elaboration of all-inclusive theoretical systems will be compared, using selections from the writings of Garfinkel, Merton and Parsons. The operating assumptions of these constructs will be contrasted.

G. Neuwirth

Not offered 1973-74

Sociology 53.505 The Sociology of Knowledge

An examination of the relationship between ideas and their social context.

Seminar two hours a week, winter term.

D. Whyte

Sociology 53.506 Theory of Social Organization and Change

The problem of order is examined in terms of alternative models dealing with continuity in social systems. In particular the relationship between value integration and conflict approaches will be examined.

R. K. N. Crook

Not offered 1973-74

Sociology 53.507 Theories of Social Change and Modernization

The course locates the analysis of change in the analysis of continuity and process of social systems. The primary substantive issue examined in the course consists of that complex of features associated with industrializing societies generally termed modernization.

Seminar two hours a week, winter term.

R. K. N. Crook

Sociology 53.509 The Philosophy of Social Science

The seminar will consider such concepts and procedures as the analysis of language in the study of scientific knowledge, the concept of cause, the inductive and anti-inductive view of science, the problem of induction, the concepts of hypothesis, scientific law and theory, the patterns of scientific explanation and prediction, and the theories of truth.

Z. A. Jordan

Not offered 1973-74

Sociology 53.510 Logical Analysis of Sociological Theory
The conditions of testability and truth, the explanatory and predictive power of sociological theories will be examined.
Seminar two hours a week, fall term.
J. Harp

Sociology 53.511 Multivariate Analysis
This course is intended to provide advanced instruction in methods and statistics. Consideration will be given to: multiple regression, factor analysis, canonical analysis.
Seminar two hours a week, winter term.
Lecturer to be announced

Sociology 53.520 Comparative Social Systems
The seminar will explore both perspectives and research procedures employed by sociologists in the systematic and explicit comparison of data from two or more societies. Major emphasis will be placed on theoretical and methodological issues in comparative research. Included among the topics for discussion are the following: the nature of sociological propositions in comparative research, the problem of conceptual equivalence, research designs and levels of analysis. Examples will be drawn from both classical and contemporary comparative studies.
Seminar two hours a week, winter term.
J. Harp

Sociology 53.521 Comparative Methods in Social Research
A seminar on the origins, contributions and current uses of comparative methods in sociology.
Seminar two hours a week, fall term.
J. deVries

Sociology 53.524 Sociology of Science and Technology
Study of the interaction among science, technology and change in modern societies.
Seminar two hours a week, fall term.
B. A. McFarlane

Sociology 53.525 Canadian Society
An analysis of Canadian social structure and institutions.
Seminar two hours a week, fall and winter terms.
F. G. Vallee and D. R. Whyte

Sociology 53.526 Sociology of Occupations and Professions
A consideration of the development of occupational recruitment patterns and manpower problems in developed and developing areas.
B. A. McFarlane
Not offered 1973-74

Sociology 53.527 Sociology of Formal Organization

A consideration of bureaucracy in modern society, government and industry.

Seminar two hours a week, winter term.

A. D. Steeves

Sociology 53.528 Departmental Seminar

Seminar topic selected annually.

Not offered, 1973-74

Sociology 53.530 Social Institutions I

Sociology of the family: a study will be made of the interrelations between the changes in power and roles within the family and changes in its structure. Emphasis will be given to the function of procreation and to policy implications.

Seminar two hours a week, fall term.

Lecturer to be announced

Sociology 53.531 Social Institutions II

Educational systems and organizations.

M. Frumhartz

Not offered 1973-74

Sociology 53.532 Human Ecology

A discussion of the interrelationships among community, social organization and environment, with particular emphasis on technology, population and culture.

Seminar two hours a week, winter term.

Lecturer to be announced

Sociology 53.535 Sociology of Religion

This seminar will concentrate upon the study of religious phenomena and systems as interpreted by classical and contemporary sociological theory. These sociological perspectives will be applied to current trends and problems related to religion in contemporary societies. The seminar will deal with four major topical areas: the sociological interpretation of religion; religion as a social system; religion, society and social change and, religion and social science.

Gordon Irving

Not offered 1973-74

Sociology 53.540 Political Sociology

An examination of the sociological dimensions of power, politics and political behaviour.

Not offered 1973-74

Sociology 53.565 Demographic Analysis

A seminar devoted to the intensive study of analytical strategies in demographic research, demographic analysis techniques and mathematical-statistical models that are relevant to the conduct of research in any area of sociology. The specific topics covered will vary from time to time to reflect the interest of the students and the instructor. They may include stable population theory, life table methods and their applications, strategies in cohort analysis, analytical techniques in fertility research, analytical techniques in mortality research, mobility models, mathematical demography, gradation methods and theory, standardization strategies and their applications.

Seminar two hours a week, fall term.

Lecturer to be announced

Sociology 53.566 Contemporary Socio-Demographic Problems

A seminar which studies the interrelationships between social organization and fertility, mortality and migration processes. The particular demographic variables studied will depend on the instructor concerned, but the emphasis will be on the way in which the independent social structural variables are related to the dependent demographic variables.

Seminar two hours a week, winter term.

G. Zubrzycki

Sociology 53.575 Workshop on Contemporary Macro-Sociological Demography and Ecological Problems

A seminar devoted to the conduct and critical review of student and faculty research on comparative social organization. Emphasis will be placed upon an explanatory analysis of demographic trends, and ecological patterns with a concentration on Canada in comparative context.

Not offered 1973-74

Sociology 53.580 Power and Stratification

An examination of theories of elite behavior, social class and ideology.

Seminar two hours a week, fall term.

G. Zubrzycki

Sociology 53.585 Selected Topics in Sociology

Lecturer to be announced

Sociology 53.586 Selected Topics in Sociology

Lecturer to be announced

Sociology 53.587 Sociology of International Relations

Consideration of interdisciplinary work in the social sciences which has concerned itself with peace research and conflict resolution. Special attention will be paid to sociological models as they have been applied to the analysis of international relations.

D. Forcese

Not offered 1973-74

Sociology 53.590, 591, 592 Tutorials

Tutorials: 590 fall term, 591 winter term, 592 spring term.

Members of the Department

Sociology 53.599 M.A. Thesis

Members of the Department

Sociology 53.601, 602, 603 Theory and Research

An examination and review of the major areas of theory and research of departmental concern in the Ph.D. program.

Seminar three hours a week: 601 fall term, 602 winter term, 603 spring term.

Lecturer to be announced

Sociology 53.690, 691, 692 Tutorials

Tutorials: 690 fall term, 691 winter term, 692 spring term.

Members of the Department

Sociology 53.699 Ph.D. Thesis

Members of the Department

SOVIET AND EAST EUROPEAN STUDIES

Director of the Institute: Teresa R. Harmstone

The Institute of Soviet and East European Studies was formed in 1963 to co-ordinate interdisciplinary studies, research, conferences and publications in this field.

Participating in the M.A. program are specialists in the Soviet and East European field from the Departments of Political Science, History, Economics, Geography, Russian, Law, and Sociology, as well as invited specialists from other universities and visiting scholars from the USSR and Eastern Europe. The program is designed for students wishing to acquire specialized knowledge of the Soviet and East European area, including proficiency in Russian.

QUALIFYING YEAR PROGRAM

Applicants with a general (pass) Bachelor's degree with at least B— standing, in one of the disciplines represented in the program, may be admitted to a Qualifying Year program designed to raise their standing to Honours status. If successful, they may be permitted to proceed to the Master's program the following year.

To be eligible for admission to the Qualifying Year program, an applicant must have already taken some courses in the area of Soviet and East European studies and, by the end of the program, he should have satisfied the following requirements:

- A reading knowledge of Russian (the equivalent of three full-courses in the Russian language).

- A total of seven full-courses (or the equivalent) in the Soviet and East European field, taken in no less than three different departments.

- A minimum grade of B— in each of the courses comprising the Qualifying Year program.

MASTER OF ARTS

Admission Requirements

The normal requirement for admission into the Master's program is an Honours bachelor's degree (or the equivalent) in Soviet and East European Studies, with at least B— standing.

A reading knowledge of the Russian language is also required. In some cases the Committee may permit another Slavic or East European language to be substituted.

Graduates in other disciplines may be admitted but will be required to complete additional courses.

Program Requirements

The specific requirements in the Master's program are the following:

- **Soviet Studies 55.500** Interdisciplinary Seminar on the Soviet Union and Eastern Europe

- Two full-courses, or the equivalent, chosen from the following list, with at least one full-course (or the equivalent) at the 500 level.

  History 24.460 Selected Problems in Russian History

  History 24.560 Late Imperial and Revolutionary Russia

  Political Science 47.415 Eastern European Politics

  Political Science 47.461 Soviet Foreign Policy

  Political Science 47.462 International Communist Movement

  Political Science 47.515 Problems in Communist Politics

  Political Science 47.516 Selected Problems in Soviet Politics

  Political Science 47.531 Selected Problems in the History of Political Thought

  International Affairs 46.510 International Relations in Eastern Europe

  Economics 43.360 Topics in International Economics

  Economics 43.571 Comparative Economic Systems

  Sociology 53.500 Seminar in Sociological Theory: Sociology of Marx

  Geography 45.531 Selected Studies in the Human Geography of Arctic and Subarctic

  Russian 36.450 Soviet Russian Literature

  Law 51.388 Socialist Legal Systems

  Law 51.520 International Economic Law I

  Law 51.521 International Economic Law II

  Law 51.491 Directed Studies

- One of the following:

  Soviet Studies 55.599 M.A. Thesis

  Soviet Studies 55.598 Research Essay; and an additional full-course (or the equivalent) chosen from among those listed above.

- An oral comprehensive examination to determine the candidate's general competence in the area and his ability to relate various disciplines to the study of the USSR and Eastern Europe.

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- A working knowledge of the Russian language and, depending on the subject of the thesis, an additional Slavic or East European language.

- Candidates are encouraged to undertake a minimum of six weeks of study at an educational institution in Eastern Europe or the Soviet Union, preferably during the Spring term. Candidates are also encouraged to take a tutorial in one East European language other than Russian offered by the Department of Russian.

Academic Standing

Master's candidates must obtain a grade of B— on all work counted for credit towards the degree.

GRADUATE COURSES

Soviet Studies 55.500 Interdisciplinary Seminar on the Soviet Union and Eastern Europe

A study of the methodological and bibliographical tools necessary for work in the area as well as of the various disciplinary approaches to the study of the Soviet Union and Eastern Europe. Attention will also be given to particular disciplines and countries not covered in regular course offerings.

Seminar and tutorials, three hours a week, fall and winter terms.

Members of the Institute

Soviet Studies 55.590, 591, 592 Tutorials in Soviet and East European Studies

A course of directed readings in selected areas of Soviet and East European Studies, involving preparation of papers as the basis for discussion with the tutor.

Tutorials three hours a week, day and evening divisions, 590 fall term, 591 winter term, 592 spring term.

Prerequisite: Permission of the Director

Members of the Institute

Soviet Studies 55.598 Research Essay

A research essay on some topic relating to the Soviet Union or Eastern Europe.

Tutorials, fall and winter terms.

Members of the Institute

Soviet Studies 55.599 M.A. Thesis

Members of the Institute

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DEPARTMENTAL PROGRAM DESCRIPTIONS
AND DETAILS OF COURSES

ENGINEERING

Aerothermodynamics
Electronics and Materials Engineering
Solid Mechanics and Structural Engineering
Systems Engineering

ENGINEERING

Programs of study are offered by the Faculty of Engineering leading to the degrees of Master of Engineering and Doctor of Philosophy in Aeronautical, Civil, Electrical and Mechanical Engineering and to the degree of Master of Engineering in Materials Engineering.

The areas of current research, the research facilities available and the graduate courses offered are given in the following pages for the four administrative divisions of the faculty:

> Aerothermodynamics
> Electronics and Materials Engineering
> Solid Mechanics and Structural Engineering
> Systems Engineering

Although each candidate will pursue his studies and research within one of these divisions, he is encouraged to take at least one half-course outside his division. Both the Master's and Doctoral programs may be undertaken on a full-time or part-time basis.

General information on awards and financial assistance is given in the awards and financial assistance section of this Calendar.

A limited number of students who are not degree candidates may be admitted to each graduate Engineering course. Credit earned as a *special student* normally *cannot* be counted towards the requirements of a graduate degree in Engineering.

MASTER OF ENGINEERING

Admission Requirements

Applicants are admitted under the general regulations specified in this Calendar but in addition are required to have strong undergraduate preparation in the appropriate Engineering disciplines, computer programming, mathematics and physics.

Program Requirements

Two alternatives are available for full-time students studying towards the degree of Master of Engineering. One involves four courses in the first term, three courses in the second term and a thesis. The other involves four courses in each of three terms and does not involve a thesis. In both cases, the candidate must take at least two graduate level courses in Engineering in each term. Usually no undergraduate engineering courses may be taken for credit. Equivalent alternate programs will be arranged for part-time students. Choice of the alternative to be taken must be arranged and approved at the time of admission into the program.

Each candidate submitting a thesis will be required to undertake an oral examination on the subject of his thesis and related fields.

Full-time graduate students and part-time thesis students are required to attend divisional seminars held regularly to discuss

current research and related topics. Each student must, of course, maintain a close working relationship with his supervisor and attend the courses in which he is registered. His supervisor may require him to submit written reports and to present seminars.

Thesis Regulations

The thesis must represent the results of the candidate's independent research or development work, undertaken after admission to graduate standing at Carleton University. Experimental or theoretical results previously published by the candidate may be used only as introductory or background material for the thesis. A candidate may be permitted to carry on thesis research work off campus providing the work is approved in advance and arrangements have been made for supervision of thesis research activities by a faculty member of Carleton University. A part-time student may use the Faculty of Engineering laboratory facilities for on-campus thesis research and development activities.

Waiver of Thesis

A candidate for the Master's degree who has, before admission, completed independent research or development projects of an adequate level of accomplishment, may apply to the Faculty of Graduate Studies for a waiver of the thesis requirement. Such application must be made at the time of initial registration and must be supported by copies of published reports describing the work. If the application is approved, the candidate must take ten half courses or the equivalent, six of which must be graduate level courses in Engineering, to fulfill the requirement for the award of a degree without a thesis. A candidate who has been granted a waiver of the thesis requirement will be required to take an oral examination on the subject of one of his published papers and topics related to his field of specialization.

Transfer of Credit

Credit for one graduate course completed at another university may be accepted in partial fulfilment of degree requirements, provided the course is appropriate to the candidate's program at Carleton. Refer to the general regulations section of this Calendar for details of the rules governing transfer of credit.

DOCTOR OF PHILOSOPHY

Admission Requirements

For admission to the doctoral program, an applicant must hold a Master's degree in Engineering (or its equivalent) and, by his previous program of study and scholastic record, demonstrate a capacity for advanced study and research. Experience gained while working in an engineering or research environment will be taken into account when assessing an application. The applicant must specify his intended field of research.

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Program Requirements

The specific program requirements for the Ph.D. degree are the following:

- A minimum of two calendar years of full-time study (or the equivalent).
- At least four graduate level half-courses in Engineering.
- At least one full-course in an appropriate discipline outside the Faculty of Engineering.
- A comprehensive examination.
- An essay which shows an appreciation of the interaction of the candidate's field of study with society, the economy and the environment.
- Substantial research.
- A thesis on the research. Each candidate will be required to make an oral presentation of his thesis research and will be examined orally on the subject of his thesis and related fields.

All full-time graduate students and all part-time students actively engaged on research are required to attend divisional seminars held regularly to discuss current research and related topics. Each student is required from time to time to present a seminar on his research.

Each Ph.D. student (full-time *or* part-time) must obtain satisfactory grades in course work, must make satisfactory progress in the research, and must satisfy the following criteria of activity or "presence" in the program:

- maintain a close working relationship with the research supervisor.
- attend the courses for which he is registered.
- submit written reports and present seminars as required by his supervisor.
- attend divisional seminars.
- be readily available on an informal basis.

Advisory Committee

On registration of a student in the program, an Advisory Committee will be appointed, consisting of at least three members. Where the research involves work in association with an outside Institution, a member of that Institution may be appointed to the Advisory Committee. It is the responsibility of the Advisory Committee to determine that all requirements for satisfactory progress and completion of the program are fulfilled.

The chairman of the Advisory Committee will act as the student's program adviser.

The research topic will be decided after consultation between the student and faculty whose interests lie in the proposed field of research. On confirmation of the research topic, a faculty member

will be appointed as research supervisor. In the case of a full-time student, this procedure is to be completed during the first year of study. For a part-time student, appointment of the research supervisor must take place prior to first registration for research.

Before the end of each year of registration in the program, the supervisor will report on the progress of the research and the Advisory Committee will review the program as a whole and recommend its continuation or otherwise. The student may be required to appear before the Advisory Committee at this time.

Comprehensive Examination

The comprehensive examination is held approximately one year after initial registration in the program in the case of full-time students, and at an equivalent time in the case of part-time students. The purpose of the examination is threefold:

- to assess the student's comprehensive knowledge of his field of study.
- to assess the preparedness and capability of the student for doctoral research.
- to judge the suitability of the research topic for a doctoral thesis.

The student is required to present his research proposal and be subjected to oral and written examination in appropriate fields of study. He will be informed by his Advisory Committee of the specific requirements of the examination. Having successfully completed the comprehensive examination, the student becomes a doctoral candidate.

Research in an Outside Institution

A student may apply for permission to carry out his research, in part or whole, in an outside Institution (e.g., industrial, governmental or university laboratory). Such an application, addressed to the Dean of Engineering, must:

- include a detailed statement of the research proposal, of arrangements for supervision and of the circumstances under which it is to be carried out.
- establish that the applicant will be able to pursue independent research.
- state the facilities available for the research.
- include a proposed time-schedule.
- be accompanied by a supporting letter from a responsible person in the outside Institution giving approval of the proposal and accepting these regulations.

Part-time Thesis Research

A part-time research program may be permitted if the conditions for the "presence" of the student listed in a previous section are satisfied. It is the responsibility of the research supervisor to

define the fraction of full-time research engaged upon by the student so that this can be appropriately credited to his program and assessed for payment of tuition fees. Before permission to undertake research on a part-time basis can be granted, the student must submit in writing, to the Dean of Engineering, a statement of his proposed manner of working part-time, supported by a letter of approval from his employer.

Computer Facilities

The Carleton University Computing and Data Processing Centre is equipped with two Xerox Data System Sigma 9 Digital Computers located in the Administration Building. The Computers have 768 thousand bytes of core storage with two card readers, one 400 cpm and the other 1500 cpm; a card punch, 100 cards per minute and two Line Printers, one 1500 lpm and the other 1100 lpm. In addition the system has

- 5 tape drives, 9 track, 800 bpi, 75 inches per second for a transfer rate of 60,000 bytes per second
- 8 removable Discpaks, which are approximately equivalent to IBM 2314's. Each stores 24 million bytes and has a transfer rate of 312.5 Kilobytes per second
- 2 Rapid Access Data (RAD) storage devices, each storing 6.29 million bytes with a transfer rate of 375 Kilobytes/sec.
- 2 High Speed RADS, each storing 5.374 million bytes with a transfer rate of 3.0 million bytes per second
- 2 Comterm Remote Job Entry Units, one in the Loeb Building and the other in the C. J. Mackenzie Building, capable of 400 cpm input and 1000 lpm output
- 6 Graphic Terminals, Datadisc type 6500 and
- provision for up to 64 conversational teletype terminals.

An IBM 1620 is now associated primarily with undergraduate instruction for both computer oriented courses and as one of the aids available to students. The XDS Sigma 9's are used for undergraduate instruction, graduate and faculty research and for Administration Data Processing. The Centre is also equipped with an off-line plotting system using a DEC PDP-8 and a UCC Digital Plotter.

Various departments have smaller, general purpose, computing systems associated with their research activities. The Faculty of Engineering, for example, has

- a PDP-15/35 with 24 thousand words of core memory and a type RF15 quarter million word disc. System peripherals include a dual DEC Tape Transport, 22 KHz A/D and D/A converters and a VT-15 Interactive Graphics Processor.
- a PDP-11/45 with 8 thousand words of core memory
- a PDP-8, with 4 thousand words of core and 2 disks totalling an additional 64 thousand words of storage. The system is interconnected with an EAI-580 Analogue Computer to form a hybrid computing system.

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AEROTHERMODYNAMICS

Chairman of the Division: W. J. Rainbird

The Division of Aerothermodynamics offers programs of study and research leading to Master's and Ph.D. degrees in Aeronautical Engineering and Mechanical Engineering.

The graduate programs and research activities of the Division are mainly directed towards study of the propulsion and aerodynamics of low and moderate speed vehicles. Gas turbine power plants are already widely used for propulsion of such vehicles and their use promises to become even more widespread. A considerable effort is therefore being devoted to the study, both analytically and experimentally, of aerothermodynamic problems relevant to gas turbine design and operation. Current studies include: flow in turbomachine annuli and blade rows; film and transpiration cooling of turbine blades; flow near rotating discs; three-dimensional boundary layer behaviour; prediction of dynamic response of single and multiple spool gas turbine units; design of highly loaded axial turbine stages; compressor and fan noise generation and suppression; propagation of complex sound waves in acoustically treated ducts. The Division of Solid Mechanics and Structures has a complementary research interest in stress analysis and vibration of turbomachinery components and offers several graduate courses in this area.

Regarding vehicle aerodynamics, the Division is interested in aerodynamic problems affecting the design, performance, operation and safety of V/STOL aircraft and in aerodynamic problems relating to ground vehicles such as air-cushion vehicles. Current studies in this area include: investigation of response of STOL aircraft to atmospheric turbulence; atmospheric turbulence in the vicinity of urban STOL ports; vortex wakes created by large aircraft; aircraft noise; boundary layer control by blowing; three-dimensional boundary layers; effects of hoar-frost roughness on airfoil performance; indirect shear stress measurement techniques.

Two additional heat transfer research areas are receiving an increased amount of attention. One is the study of mixing and heat transfer in nuclear power reactors. The other involves the computer simulation of the performance of building environmental control systems. Particular emphasis is being placed on the prediction of the part-load characteristics of components such as the air cooling coil.

The laboratories of the Division are well equipped for the various research studies. Facilities include a closed return low-turbulence wind tunnel with a three component balance; an annular swirl tunnel; extensive hot-wire anemometry; a spinning mode sound generator in an annular duct; acoustic signal recording and processing equipment; cold room. The extensive aerodynamic and other test facilities of the National Research Council are also used, by special arrangement, on a cooperative basis.

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GRADUATE COURSES

Engineering 88.501 Theory of Viscous and Turbulent Flows

Fundamental concepts of viscous flow; derivation of Navier-Stokes equations; Prandtl's boundary layer approximation; momentum integral methods; incompressible and compressible laminar and turbulent boundary layers; stability; transition; turbulent flow; flow separation; transformation methods; shock wave-boundary layer interaction; semi-empirical solution of turbulent skin friction and heat-transfer problems.

Lectures three hours a week, fall term.

Reference: Schlichting, *Boundary Layer Theory*

D. W. Dunn and W. J. Rainbird

Engineering 88.502 Hypersonic Flow

Basic equations of inviscid, unsteady hypersonic flow. Small disturbance theory. Newtonian Theory. Optimum slender and non-slender body shapes. Hypersonic flow past oscillatory wedges and cones. Viscous hypersonic flow theory. Diffusion in hypersonic boundary layers. Solution of non-equilibrium flows including shock waves. Equations of rarefied gas flows.

Also listed as Mathematics 70.643

Lectures three hours a week, fall and winter terms.

P. Mandl

Engineering 88.503 Incompressible Nonviscous Flow

Derivation of the fundamental equations for inviscid incompressible and compressible flow; solution of two-dimensional potential flows by complex variable methods; axi-symmetric potential flows; vortex motion; low-speed airfoil and cascade theory; wing lifting-line theory.

Lectures three hours a week, fall term.

References: Robertson, *Hydrodynamics in Theory and Application*
Houghton and Brock, *Aerodynamics for Engineering Students,* Ch. 10 to 13

A. N. Abdelhamid

Engineering 88.504 Compressible Nonviscous Flow

One dimensional steady isentropic, frictional and diabatic flow; normal and oblique shock waves, irrotational compressible flow, small perturbation theory and similarity rules, supersonic nozzle contour design, supersonic nozzle and diffuser flow analysis, second-order supersonic airfoil theory, unsteady one-dimensional flow.

Lectures three hours a week, winter term.

References: Shapiro, *Dynamics and Thermodynamics of Compressible Fluid Flow*
Liepmann and Roshko, *Elements of Gas Dynamics*

A. N. Abdelhamid

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Engineering 88.505 Aerodynamics of Wings and Bodies

Numerical methods for calculation of the aerodynamic forces acting on air-foils, wings and bodies. Aerodynamic influence coefficients; method of boxes; collocation method; interference; unsteady aerodynamics. Basic concepts of several related computer programs and their application.

Lectures three hours a week, winter term.

Text: Ashley and Landahl, *Aerodynamics of Wings and Bodies*

J. J. Kacprizynski

Engineering 88.508 Experimental Methods of Aerothermodynamics

Principles of flow measurement and visualization. Optics and optical systems. Pressure, temperature and velocity measurement in high speed flows, and in boundary layers. Flow visualization methods, three dimensional and skewed boundary layers. Skin friction and heat transfer. Data recording, logging and analysis. Test facilities.

Lectures three hours a week, winter term.

References: Landenburg, *Physical Measurements in Gas Dynamics and Combustion,* Vol. 9 Princeton Series
Donovan, *Problems of High Speed Aircraft and Experimental Methods,* Vol. 8 Princeton Series

D. A. J. Millar

Engineering 88.509 Advanced Topics in Fluid Dynamics

Recent and advanced topics in fluid dynamics selected from recent publications. Students registered in the course are expected to present one or more lectures or seminars on assigned topics.

Lectures and seminars three hours a week, one term.

Prerequisites: Engineering 88.501, 88.503, and 88.504 or equivalent.

Lecturer to be announced

Engineering 88.510 Performance and Economics of V/STOL Aircraft

Review of aircraft drag estimation and power plant performance data. High lift systems. Generalized momentum analysis for this class of vehicles. Performance analysis and simulation. Direct and indirect operating costs; route analysis and operational problems, including noise.

Lectures, seminars, and laboratories, three hours a week, winter term.

Prerequisite: Engineering 88.511 or equivalent.

References: Dommasch, Sherby and Connolly, *Airplane Aerodynamics*
Kuchemann and Weber, "An Analysis of Some Performance Aspects of Various Types of Aircraft Designed to Fly over Different Ranges at Different Speeds," in *Progress in Aeronautical Sciences,* Volume 9

W. J. Rainbird, R. J. Templin, and R. Taborek

Engineering 88.511 Dynamics and Aerodynamics of Low-Speed Flight

Brief review of static stability theory. Euler's equations for rigid body motion; the linearized equations of motion; stability derivatives and their estimation. Longitudinal and lateral dynamic response of an aircraft to control and disturbance. STOL performance considerations; rotor, propeller and ducted fan analysis and design; jet flaps; powered-lift schemes.

Lectures three hours a week, fall term.

References: McCormick, *Aerodynamics of V-STOL Flight*
         Etkin, *Dynamics of Atmospheric Flight*

Lecturer to be announced

Engineering 88.513 Structural Dynamics and Aeroelasticity

Review of string and beam vibrations. Vibrations of membranes and plates. Theory of normal modes and solution by normal mode expansions. Fourier transform methods. Matrix methods and finite element techniques. Vibration of built-up bodies, multi-bay panels, complete aircraft. Introduction to flutter, wing divergence, classical wing flutter, panel flutter.

Lectures three hours a week, fall term.

References: Hurty and Rubenstein, *Dynamics of Structures*
         Biggs, *Structural Dynamics*
         Fung, *Theory of Aeroelasticity*

Not offered 1973-74

Engineering 88.530 Acoustics and Noise

Fundamentals of vibrations of solids and fluids; plane waves, spherical waves. Transmission and reflection; acoustic impedance and matching. Resonators and filters. Absorption in fluids. Introduction to acoustic measurements; loudspeakers, microphones. Introduction to aero-acoustics and jet noise.

Lectures two hours a week, fall term.

Laboratory and problem analysis three hours alternate weeks, winter term.

Text: Kinsley, Frey, *Fundamentals of Acoustics*

References: Beranek, *Noise Reduction*
         Rschevkin, *Theory of Sound*

ASTM Standards, Thermal Insulation; Acoustical Materials; Fire tests; Building Construction, November 1966.

A. N. Abdelhamid

Engineering 88.531 Aero-acoustics

Acoustic wave motion; the wave equation and solutions; energy density and sound intensity, acoustic impedance, reflection, refraction and diffraction of sound waves. Radiation of sound; simple source, periodic simple source; dipole and quadruple source; examples. Source impedance, moving sources and Doppler effect. Acoustic transmission: ducts, tubes; standing waves. Lighthill's theory of jet noise spectra and directivity; jet noise sup-

pressors; supersonic jet noise, sonic boom; noise from fans, compressors and propellers.

Lectures three hours a week, fall term.

Text: Richards, Mead, *Noise and Acoustic Fatigue in Aeronautics*

References: Morse, Ingard, *Theoretical Acoustics*
Malecki, *Physical Foundations of Technical Acoustics*

Not offered 1973-74

Engineering 88.541 Turbomachinery

Non-dimensional parameters and similarity. Energy and torque relations for rotating coordinate systems. Radial equilibrium equations. Cascades: flow; performance and testing. Axial flow turbomachines: energy relations, flow patterns, types, characteristics and design. Radial flow turbomachines: energy relations, flow patterns, types, characteristics and design. Viscous flow and boundary layer effects, skewed boundary layers and cross flows, secondary flows. Compressor surge and rotating stall.

Lectures three hours a week, fall term.

References: Shepherd, *Principles of Turbomachinery*
NASA SP 36, *Aerodynamics Design of Axial Flow Compressors*
Horlock, *Axial Flow Compressors*
Horlock, *Axial Flow Turbines*

H. I. H. Saravanamuttoo

Engineering 88.542 Gas Turbines

Inter-relations between thermodynamic, aerodynamic and mechanical design. Choice of cycles for different applications. Design-point cycle calculations. Analysis of fundamental components—compressors, turbines, combustors, nozzles, heat exchangers, etc. Cycle optimization; shaft power, turbojet and turbofan units. Off-design performance; component characteristics, theory of equilibrium operation. Influence of off-design performance on control design and transient response.

Lectures three hours a week, winter term.

References: Hesse and Mumford, *Jet Propulsion for Aerospace*
Sawyer, *Gas Turbine Engineering Handbook*

E. P. Cockshutt

Engineering 88.543 Advanced Thermodynamics

Systems, environment, states, properties, processes, cycles. Work and heat interactions. Equilibrium, reversibility, irreversibility. First Law. Energy. Non-flow, steady flow and unsteady flow processes. Second Law. Thermodynamic temperature scale. Entropy. Equations of state, Maxwell relations, phase rule. One-component and multi-component systems. Mixtures and solutions. Thermodynamic potentials. Chemical reactions and chemical

equilibrium. Applications to special systems. Statistical and probabilistic interpretations of thermodynamics.

Lectures three hours a week, fall term.

References: Sonntag and Van Wylen, *An Introduction to Thermodynamics, Classical and Statistical*

Hatsopoulos and Keenan, *Principles of General Thermodynamics*

Zemansky and van Ness, *Basic Engineering Thermodynamics*

Bosnjakovic and Blackshear, *Technical Thermodynamics*

J. T. Rogers

Engineering 88.544 Statistical Thermodynamics

Maxwell-Boltzman, Bose-Einstein, and Fermi-Dirac statistics are derived, and applied in appropriate physical situations. The relation between thermodynamics and statistical mechanics is considered. Kinetic and transport theories are covered.

This course is also offered as Physics 75.447, Statistical Physics.

Lectures three hours a week, fall term.

Text: Kittel, *Statistical Physics*

L. Resnick

Engineering 88.546 Advanced Topics in Heat Transfer

Advanced topics in heat transfer selected from recent publications. During the 1973-74 session the course will deal with two-phaseflow and heat transfer.

Lectures and seminars, three hours a week, one term.

Prerequisites: Engineering 88.547 and 88.548.

J. T. Rogers

Engineering 88.547 Conductive and Radiative Heat Transfer

General heat conduction equation, similitude, electrical analogy. Steady one- and multi-dimensional systems; solution of the governing equations directly and numerically. Transient conduction with both steady and unsteady boundary conditions of various types; analytical and numerical solutions. Introduction to radiative heat transfer: surface radiation, athermanous media, radiation properties, property measurement. Surface radiative interchange; black, gray, non-gray, non-diffuse surfaces; angle factors. Radiative interchange with athermanous media.

Lectures three hours per week, fall term.

References: Arpaci, *Conduction Heat Transfer*

Sparrow and Cess, *Radiation Heat Transfer*

R. C. Biggs

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Engineering 88.548 Convective Heat and Mass Transfer

Review of the basic conversation principles and flux laws involved in momentum, heat and mass transfer: Derivation of the boundary layer equations in both differential and integral forms. Study of momentum and then heat transfer, pointing out the analogous behaviour: laminar and turbulent, internal and external flows. The objective is a thorough understanding of the physical processes involved, and the "classical" methods of solution. Effects of free convection, non-constant properties, high velocity flows. Laminar, turbulent mass transfer, pointing out the mass, heat transfer analogy.

Lectures three hours per week, winter term.

Text: W. M. Kays, *Convective Heat and Mass Transfer*

R. C. Biggs

Engineering 99.596 Directed Studies

Engineering 99.599 M. Eng. Thesis

Engineering 99.699 Ph.D. Thesis

Other Engineering courses of particular interest to students in the Division of Aerothermodynamics include:

Engineering 82.513 Finite Element Methods in Stress Analysis

Engineering 82.517 Experimental Stress Analysis

Engineering 82.534 Transportation Planning I

Engineering 82.541 Ground Transportation Systems and Vehicles

Engineering 82.550 Advanced Vibration Analysis

Engineering 82.561 Design Theory and Practice

Engineering 82.562 Failure Prevention

Engineering 94.553 Stochastic Processes

Engineering 94.560 Advanced Engineering Application of
Digital Computers

Engineering 97.572 Deformation of Materials

ELECTRONICS AND MATERIALS ENGINEERING

Chairman of the Division: A. R. Boothroyd

The Division of Electronics and Materials Engineering offers programs of study and research leading to the Master's degree in Electrical Engineering and Materials Engineering, and to the Ph.D. degree in Electrical Engineering.

The graduate programs are directed towards study and research in the following inter-related fields:

- Solid State Device Electronics
- Circuits and Circuit Theory
- Microwaves, Optics and Electromagnetics
- Materials Engineering

The structure of the courses offered allows a well-integrated Master's or Ph.D. program of study to be chosen, appropriately related to the field of thesis research. In Electronics, the course topics cover basic solid state physics, semiconductor device theory, and circuit and electromagnetic theory. The courses in Materials Engineering include both introductory and advanced treatments of the structures and properties of materials, with emphasis placed on metals.

The major research program in the division is in the field of solid state electronics. Areas of research activity include:

- Physics of devices.
- Semiconductor device development and innovation.
- Device fabrication processes.
- Modelling (characterization and simulation) of device structures.
- Microwave circuit applications.
- Device applications in integrated circuits.

Modelling forms a central theme and is concerned with relationships between fabrication processes, internal device mechanisms and circuit performance; it is of particular relevance to computer-aided design of devices and circuits. Device research topics include semiconductor surface and bulk studies in relation to insulated gate, Schottky barrier and bipolar device structures; photo-excitation and strain effects in semiconductors, with interest in transducer devices; avalanche breakdown in connection with IMPATT diodes and other microwave structures. Research on circuit applications of devices is concerned with microwave power generation and amplification, micro-strip circuits, linear active integrated circuits. Other areas of study are microwave and optical interferometry, lasers, holography, and time domain reflectometry.

Extensive facilities are available for the fabrication of solid state devices for research purposes. These facilities include a laboratory in which processes required in silicon monolithic and thin film technology can be carried out under conditions of cleanliness and control comparable with those in industrial research laboratories. Among the equipment items available are modern diffusion furnaces, facilities for photolithography, vacuum systems for thin film deposition, scribing, bonding and probing

systems. There are extensive provisions for device characterization. Well-developed laboratory facilities exist for circuit work, particularly at microwave frequencies. Other facilities include spectroscopic equipment and a 60 kJ capacitor bank used for plasma studies.

The research program in Materials Engineering concentrates mainly on electron beam technology. Specific projects include electron beam conditioning of ingots, billets and powders; electron beam welding of railway rails and structural members; microfabrication of electronic devices; scanning electron beam microscopy. A well-equipped laboratory includes a 130kV-14mA and a 70kV-685mA electron beam system.

GRADUATE COURSES

Engineering 94.563 Communications Technology

Current engineering practice in communications systems design. The performance and interconnection of subsystems which make up multichannel transmitters and receivers. Topics to be discussed include modulation, multiplexing, solid state microwave signal sources and amplifiers, transmission systems and receivers. This course is offered jointly by the Division of Electronics and Materials Engineering and the Division of Systems Engineering.

Lectures three hours a week, winter term.

Prerequisite: Engineering 94.553 or equivalent experience.

Reference: W. R. Bennett and J. R. Davey, *Data Transmission*

D. R. Conn

Engineering 97.515 Introduction of Plasma Dynamics

Basic theory of electrically conductive gases. Motion of non-interacting charged particles in electromagnetic fields. Effects of collisions on motion, scattering and collision physics, Boltzmann transport theory, diffusion equations and relation of electrical conductivity to particle motions, Debye shielding, Alfven waves. Non-neutral plasmas such as exist in sheathes and electrofluiddynamic devices. Collision dominated plasmas — the magnetofluiddynamic equations.

Lectures three hours a week, fall term.

Not offered 1973-74

Engineering 97.550 Physics of Semiconductor Materials and Devices

The aim of the course is to develop a fundamental understanding of the physical concepts basic to electron devices — and to the treatments of semi-conductor devices given in courses 97.580 and 97.558.

Topics include band concepts, thermostatics of semiconductors, detailed statistics of semiconductors, quasi-Fermi levels and recombination kinetics, trapping processes, photoconductivity, non-equilibrium transport processes.

Lectures three hours a week, fall term.

References: Nussbaum, *Semiconductor Device Physics*
van der Ziel, *Solid State Physical Electronics*
Bube, *Photoconductivity of Solids*

M. A. Copeland

Engineering 97.551 Applied Electromagnetic Theory

A linear theory of electromagnetic propagation in isotropic and aniso-tropic conducting media. Radiation. The plane wave spectrum representa-tion of electromagnetic fields. Fourier transforms, aperture distribution and radiation patterns. Near field radiation patterns and on-axis gain. The geometrical theory of diffraction and its application to microwave antennas. Radiation from small apertures. Guided waves: TEM striplines. Propagation of cylindrical waveguides of arbitrary cross section. Equivalent circuits of some obstacles in waveguides by variational methods. Finite difference solution of waveguide problems by computer.

Lectures three hours per week, fall term.

References: Selected papers.

V. Makios

Engineering 97.555 Passive Circuit Theory

General description of networks leading to matrix representation of n-terminal lumped and distributed networks. Elements of matrix algebra as applied to networks. Properties of network functions; poles and zeros of driving point and transfer functions. Foster and Cauer canonic forms. Synthesis of lossless 2-ports; single and double-terminated. Modern filter theory; approximation of characteristics by rational functions; Butterworth and Chebyshev approximations.

Lectures three hours per week, fall term.

Text: To be announced.

P. D. van der Puije

Engineering 97.557 Active Circuit Theory

Characterization of negative resistance 1-port networks; application to signal generation and amplification.

Active 2-ports and their mathematical description in terms of y, z, h, k, chain and scattering parameters. Measurement of 2-port parameters. Acti-vity and passivity; reciprocity, non-reciprocity and anti-reciprocity. The gyrator as a circuit element. Stability, inherent and conditional; power gain of conjugate and mismatched 2-port amplifiers. Amplifier gain sensitivity. Oscillators, maximal loading and frequency sensitivity.

Principles of active filter design; the gyrator, the negative immittance con-vertor (NIC) and the operational amplifier used as functional elements. Practical realization of gyrators and NIC's. Active network synthesis.

Prerequisite: Engineering 97.555 Passive Circuit Theory (or equivalent)

Lectures three hours per week, winter term.

Reference: R. Spence, *Linear Active Networks.*

P. D. van der Puije

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Engineering 97.558 Surface-Controlled and Special Purpose
Semiconductor Devices

Review of the theory of semiconductor surfaces and interfaces. Surface characterization. Study of surface dependent devices: MIS capacitors, gate controlled (field plate) diodes, MIS transistors. MIS memory elements, metal-semiconductor contacts. Complementary MOS transistors. Charge-coupled devices. Schottky barrier devices. Fast bipolar transistors with shallow junctions. Lateral transistor. Surface recombination. Special devices of topical interest.

Lectures three hours a week, winter term.

Prerequisite: Engineering 96.580 or equivalent.

References: S. M. Sze, *Physics of Semiconductor Devices*
A. S. Grove, *Physics and Technology of Semiconductor
Devices*
Selected Papers
Cobbold, *Theory and Application of Field Effect Transistors*

R. E. Thomas

Engineering 97.559 Solid State Devices Fabrication Technology

Processes used in fabrication of silicon planar devices and integrated circuits. Crystal growth, epitaxy, thermal oxidation, solid state diffusion, vacuum processes, photolithography. Characterization and limitation of processes. Design consideration for discrete devices and integrated circuits. Methods of material, process and device assessment. Thin film technology. Recent ion implantation developments in fabrication technology. Processes for other semiconductors.

Lectures three hours a week, fall term.

References: S. K. Ghandi, *The Theory and Practice of Microelectronics*
A. S. Grove, *Physics and Technology of Semiconductor
Devices*

R. E. Thomas

Engineering 97.561 Quantum Fundamentals of Electronics

The notations of quantum mechanics are explained then used for the description of quantum phenomena in semiconductors and lasers. The emphasis is on engineering applications and such topics as energy level diagrams, spectroscopy, transition probabilities, tunnelling, thermionic and field emission, band theory, effective mass, dissociation and ionization, photon induced transitions, coherent radiation, photodiodes and photon-emitting diodes, solar cells, solid state lasers, semiconductor lasers and gaseous lasers are covered.

Lectures three hours a week, winter term.

References: Levine, *Quantum Physics of Electronics*
Lindsay, *Introduction to Quantum Mechanics
for Electrical Engineers*
Chang, *Principles of Quantum Electronics*

G. D. Cormack

Course to be offered 1973-74 but not 1974-75.

Engineering 97.562 Microwave Solid State Electronics

Discussion of basic principles of operation of varactor diodes, p-i-n diodes, microwave switches, limiters and phase shifters, Schottky barrier devices, detector and mixer diodes, avalanche transit-time microwave diodes and bulk gallium arsenide devices.

Lectures three hours a week, fall term.

References: H. A. Watson, *Microwave Semiconductor Devices and Their Circuit Application*
S. M. Sze, *Physics of Semiconductor Devices*

D. R. Conn

Engineering 97.570 Structure of Materials

The theory of diffraction of x-rays, electrons and neutrons by single crystals, polycrystals and liquids is developed. Methods of determining lattice parameters, crystal structures and crystal perfection are discussed.

Lectures three hours a week, winter term.

References: James, *Optical Principles of X-Ray Diffraction*
Gunier, *X-Ray Diffraction*

J. A. Goldak
Either 97.570 or 97.571 will be offered

Engineering 97.571 Special Topics in Materials Engineering I

The course emphasizes electron beam technology. Topics presented include: Electron beam systems — cathode materials, electron guns, electron lenses and aberrations. Back scattering and secondary electron emission, x-ray fluorescence, cathodoluminescence and thermal effects. Radiation hazard and radiation chemistry. Electron beam welding.

Lectures three hours a week, winter term.

J. A. Goldak
Either 97.570 or 97.571 will be offered

Engineering 97.572 Deformation of Materials

Mechanical materials testing: tensile, compression, torsion, hardness, impact, fatigue, creep and stress rupture. Elastic deformation and anelasticity; plastic deformation and dislocations. The Bauschinger effect and preferred orientation. Fracture in ductile and brittle materials. The mechanical properties of metals and alloys, ceramics, concretes, composites, polymers and graphite.

Lectures three hours a week, fall term.

References: Hayden et al, *The Structure and Properties of Materials Vol. III, Mechanical Behaviour*
Deiter, *Mechanical Metallurgy*

M. J. Bibby
Either 97.572 or 97.573 will be offered

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Engineering 97.573 Special Topics in Materials Engineering II

In 1972-73, the course will emphasize modern fabrication and analytical techniques in physical electronics and materials. Electron and ion beam fabrication techniques. Electron beam degassing, refining, machining, and joining. Ion beam processing, cathodic etching. Thin film deposition-evaporation and sputtering. The interaction of light with light sensitive polymers — photochemical fabrication, anodizing. Electron and ion beam analytical techniques, scanning electron microscope, auger spectroscopy and mass spectrum techniques.

Lectures three hours a week, fall term.

References: Berry, *Thin Film Technology*
Bahish (Editor), *The Electron and Ion Beam technology Series*

M. J. Bibby

Either 97.572 or 97.573 will be offered

Engineering 97.580 Theory of Semiconductor Devices

Review of solid state physics underlying device mechanisms. Equilibrium and non-equilibrium conditions in a semiconductor. Physical theory of basic semiconductor device structures and aspects of design: PN junctions and bipolar transistors. Charge control theory. Modelling of device mechanisms. Large and small signal models of bipolar transistors. Performance limitations of transistors.

Lectures three hours a week, fall term.

References: Adler et al, *Introduction to Semiconductor Physics S.E.E.C. I.*
Gray et al, *Physical Electronics and Circuit Models of Transistors, S.E.E.C. II*
Grove, *Physics and Technology of Semiconductor Devices*

A. R. Boothroyd

Engineering 97.582 Coherent Electromagnetic Theory and Optics

The course will combine topics in coherent optics and their relevance in communication theory. Topics to be handled: analysis of two-dimensional linear systems, scalar diffraction theory, as well as Fresnel and Fraunhofer diffraction. Fourier transforming and imaging properties of lenses, frequency analysis of optical imaging systems, spatial filtering and optical information processing. Laboratory demonstrations of wavefront reconstruction imaging (holography) will give the student the opportunity to apply the theory.

Lectures three hours per week, winter term.

Reference: Goodman, *Introduction to Fourier Optics*

V. Makios

Engineering 97.585 Modern Integrated Circuit Systems

A study of the interaction between modern integrated circuit technology and potential new systems applications. Topics include logic modules, linear operational amplifiers, MOS shift registers and memories, light imaging and emitting arrays, charge transfer devices. Important questions include: What is and will be available? How can it be used? What new systems are therefore possible? What economic and social impact?

Lectures three hours a week, winter term.

   References: Selected Papers

M. A. Copeland

Engineering 97.586 Computer Aided Circuit Design

The course will be concerned with the application of computer methods in circuit analysis and design. Topics will include matrix analysis, topological methods, state space techniques, numerical analysis, modelling of solid state devices, optimization techniques. DC, transient and AC small and large signal analysis of linear and and nonlinear circuits will be treated.

Lectures three hours a week, winter term.

Reference: Calahan, *Computer-Aided Network Design*

J. P. Knight

Engineering 97.589 Advanced Topics in Electronics

A course dealing with selected advanced topics of recent interest in the broad field of solid state devices, electronic circuits and electromagnetics. Specified topic offered to be announced each year. Primary references are recent publications in the field concerned. The course will usually be given on a seminar basis and students registered for the course may be expected to make presentations on assigned topics.

Lectures three hours a week, fall term.

Prerequisite: Appropriate background in the field concerned; courses to be specified.

Lecturer to be announced

Engineering 99.596 Directed Studies

Engineering 99.599 M.Eng. Thesis

Engineering 99.699 Ph.D. Thesis

SOLID MECHANICS AND
STRUCTURAL ENGINEERING

Chairman of the Division: D. J. L. Kennedy

The Division of Solid Mechanics and Structural Engineering offers programs of study and research leading to the Master's and Ph.D. degrees. in Civil Engineering and Mechanical Engineering.

The discipline of Solid Mechanics is basic to structural and machine design. The graduate program in solid mechanics emphasizes the following fields: mechanical analysis and design of turbomachinery; vehicle dynamics and vehicle-soil interaction; analysis of shells; design and optimization of mechanical components and systems by computer methods.

The graduate studies in the mechanical design of turbomachinery complement the interest of the faculty in the fluid mechanics of turbomachinery, as well as the interests of local industry and the National Research Council laboratories. Topics presently under investigation in this area include: stresses, deflections, and vibrations of compressor and turbine stages; dynamics of high speed rotors; and optimum design of blades and discs. Current research in the area of vehicle mechanics includes: effect of vibration on vehicle performance, parameters of off-road vehicles.

The facilities for experimental studies include: equipment for stress analysis by photoelastic techniques; a 2000 pound force vibration table with instrumentation for dynamic studies; laser-holographic apparatus for stress and vibration analysis; equipment for studies of rotor dynamics; apparatus for investigating the effect of vibrations on vehicle performance.

The graduate program in structural engineering emphasizes the following fields: theory of structures; computer applications in structural analysis and design; structural systems and design optimization; behaviour and design of reinforced concrete members and structures; fatigue and creep of concrete; behaviour and design of steel structures, with emphasis on structural stability and inelastic behaviour. The main areas of advanced study are related to building structures.

Laboratory facilities include a 400,000 lb. universal testing machine with auxiliary equipment for load and strain control; Electro-hydraulic Servo Controlled Testing System of 100,000 lb. dynamic capacity; a 10,000 lb. fatigue testing machine; a precision type materials testing machine; specialized equipment for torsion and impact studies; advanced equipment for electric resistance strain gauge work; and a wide selection of other loading, measuring and recording equipment for testing structural materials and components. The concrete laboratory has facilities for the casting, curing and testing of reinforced concrete members.

A library of computer programs for structural engineering, currently in the development stage, is a significant resource for advanced study and research.

The studies in Soil Mechanics are directed primarily toward the theoretical explanation of soil behaviour under various dynamic loading

conditions such as earthquakes and moving wheels. In addition the group is engaged, along with the Departments of Geology and Geography, in developing a program of studies in Earth Sciences to provide an improved insight into the engineering properties of soil through the study of the physics and chemistry of the soil system. The Soil Mechanics, Soil Dynamics, the Highway Materials Laboratories provide facilities for the studies of the physical properties of soil, stabilized soil, aggregate, and bituminous mixtures.

Transportation studies stress the planning and analysis of transportation systems. The technological as well as the sociological and economic aspects of the various modes of transportation, with some emphasis on the highway, are under examination with a view toward providing a sound background against which planning decisions can be made. Air transportation systems are being studied within the same framework. In addition, some activity has been devoted to topics such as Traffic Safety and Highway Aesthetics.

GRADUATE COURSES

Engineering 82.511 Introductory Elasticity

Concepts of stress, strain and displacement of homogeneous isotropic materials. Plane elasticity, stress functions, selected problems using matrix inversion and computer solutions of harmonic and biharmonic stress function equations. Interference and rotational stresses. Stress concentration. Introduction to elastic/plastic effects. Introduction to general theory of three dimensional elasticity. Stress functions in polar coordinates.

Lectures three hours a week, fall term.

Reference: Timoshenko and Goodier, *Theory of Elasticity*

C. R. Thompson

Engineering 82.512 Advanced Elasticity

Continuation of concepts of stress and strain and stress functions introduced in 82.511. Strain-Energy methods. Torsion-thermal stresses. Complex variable solutions. Computerized solutions.

Prerequisite: Engineering 82.511 or consent of instructor.

Lectures three hours a week, winter term.

References: Timoshenko and Goodier, *Theory of Elasticity*
         Wong, *Theory of Elasticity*

C. R. Thompson

Engineering 82.513 Finite Element Methods in Stress Analysis

This course deals with the application of finite element methods to the solution to stress problems that are encountered in engineering design. The following topics are treated: Selected topics from matrix algebra. Triangular, rectangular and quadrilateral element stiffness matrices. Stiffness and flexibility matrices for an assembly of elements. Stresses in plates with

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inplane loading and lateral loading. Stress in axi-symmetric shells and solids. Introduction to non-linear problems and to dynamic systems.

Lectures three hours per week, winter term.

Text: Desi and Abel, *Introduction to the Finite Element Method*

References: Zienkiewicz, *The Finite Element Method in Engineering Science*
Holland and Bell, *Finite Element Methods in Stress Analysis*

W. H. Bowes

Engineering 82.517 Experimental Stress Analysis

Photoelasticity: two-dimensional stress fields, models, types of polariscope, the shear difference method, relaxation solution of Laplace's equation, oblique incidence, isotropic points. Three-dimensional stress fields, frozen patterns, scattered light analysis. Formulae for photoelastic coating; photoelastic strain gauges. Gauge factors, loading effects on strain gauge bridges, balancing, cross and null balance sensitivity, calibration and temperature compensation. Models and analogues, soap film. Moire fringes, brittle lacquer, mechanical and optical strain gauges.

Lectures three hours a week, fall term.

References: Frocht, *Photoelasticity*
Dally and Riley, *Experimental Stress Analysis*
Durelli and Riley, *Introduction to Photomechanics*

G. W. Bigg

Engineering 82.522 Theory of Plates and Shells

Circular and rectangular plates with small deflections; introduction to large deflection theory of plates; membrane theory of shells; bending of shells of revolution and cylindrical shells.

Lectures three hours a week, fall term.

Reference: Timoshenko and Woinowsky-Krieger, *Theory of Plates and Shells*

Lecturer to be announced

Engineering 82.523 Theory of Structural Stability

Elastic and inelastic behaviour of beam-columns; elastic and inelastic buckling of frames; application of energy methods to buckling problems; lateral-torsional buckling of columns and beams; buckling of plates; local buckling of columns and beams.

Lectures three hours a week, winter term.

Prerequisite: Engineering 82.525 or equivalent.

Reference: Timoshenko and Gere, *Theory of Elastic Stability*

Lecturer to be announced

Engineering 82.524 Behaviour of Steel Structures

Steel as a structural material; bolted and welded connections; brittle fracture and fatigue; members subjected to combined bending and compression, and to twist and local buckling, including inelastic behaviour; structural stability of multi-storey rigid frames, including inelastic behaviour; thin-webbed girders.

Lectures three hours a week, winter term.

Reference: McGuire, *Steel Structures*

D. J. L. Kennedy

Engineering 82.525 Analysis of Elastic Structures

Application of matrices to structural analysis; the deflections of determinate structures; force and displacement methods of matrix analysis applied to a graded series of examples, leading to general methods of analysis for framed indeterminate elastic space structures; techniques for the analysis of large structures; general structural theorems; introduction of energy methods; introduction to structural dynamics.

Lectures three hours a week, fall term.

Reference: Beaufait, Rowan, Hoadley and Hackett, *Computer Methods of Structural Analysis*

J. Kirkhope

Engineering 82.526 Prestressed Concrete

Prestressed concrete general considerations; prestressing methods; determination of losses of prestress; analysis and design of tension members, pretensioned beams, post-tensioned beams, continuous beams; ultimate strength and shear strength considerations; precast concrete members; selected problems in prestressed concrete.

Lectures three hours a week, winter term.

References: Khachaturian and Gurfinkel, *Prestressed Concrete*
Lin, *Design of Prestressed Concrete Structures*
Leonhardt, *Prestressed Concrete*
Kani, *Spannbeton*
Preston and Sollenberger, *Modern Prestressed Concrete*

Lecturer to be announced

Engineering 82.527 Advanced Structural Design

A number of advanced topics in structural design will be selected, by members of the staff and other specialists from the professional community, from such areas as aesthetics, structural form, load analysis, design against earthquake, wind and fire.

Lectures three hours a week, winter term.

Lecturer to be announced

Engineering 82.528 Advanced Reinforced Concrete

The research background, development, and limitations of current NBC and ACI building code provisions in the following areas: Properties of con-

crete and reinforcing under load; structural safety; strength and behaviour of reinforced concrete members under bending, combined bending and axial load, shear, torsion, combined torsion, bending and shear; bond behaviour, serviceability analysis and considerations; strength and behaviour of reinforced concrete columns; strength and behaviour of reinforced concrete slabs; limit analysis of reinforced concrete structures.

Lectures three hours a week, fall term.

References: Proceedings and special publications of the American Concrete Institute
Proceedings of the American Society of Civil Engineers

R. F. Manuel

Engineering 82.529 Foundation Engineering — Case Histories

A critical study by consideration of case histories of current procedures of design and construction of foundations, earth retaining structures, and earth slopes.

Lectures three hours a week, fall term.

References: Selected reports.

E. B. Fletcher

Engineering 82.530 Advanced Soil Mechanics I

Clay mineralogy and physical chemistry of soils; effective stress, elastic equilibrium, pore pressure parameters; saturated and partially saturated soils; seepage, consolidation and settlement; shear strength.

Lectures three hours a week, fall term.

References: Scott, *Principles of Soil Mechanics*
Wu, *Soil Mechanics*

Lecturer to be announced

Engineering 82.531 Advanced Soil Mechanics II

Plasticity in soil mechanics, failure and yield criteria, plastic equilibrium, upper and lower bound solution, statically admissible and kinematically admissible states, stability analysis for cohesive and cohesionless soils, bearing capacity.

Lectures three hours a week, winter term.

References: Wu, *Soil Mechanics*
Scott, *Principles of Soil Mechanics*

Lecturer to be announced

Engineering 82.532 Advanced Soil Mechanics III

Theoretical and empirical methods of determining the shear strength and compressibility of soils. Bearing capacity theories; theory of consolidation. Applications to shallow and deep foundations.

Lectures three hours a week, winter term.

References: Leonards, *Foundation Engineering*
Selected Papers

Lecturer to be announced

Engineering 82.533 Pavement Design

Characterization of highway and airport traffic loads; stresses and load distribution in single and multi-layer flexible and rigid pavements; pavement behaviour under static, transient and repeated loads; interpretation and application of strength properties of subgrade soils and paving materials; theoretical and empirical design methods for flexible and rigid highway and airport pavements; pavement performance evaluation; pavement test roads; current research developments.

Lectures three hours a week, winter term.

References: Yoder, *Principles of Pavement Design*
International Conference on Structural Design of Asphalt Pavements
C.G.R.A. Guide to Structural Design of Flexible and Rigid Pavements in Canada

D. A. Kasianchuk

Engineering 82.534 Transportation Planning I

The objectives of transportation planning. Planning process of transport systems; the systems approach. Interaction of transport modes in regional transport systems. Modelling demand for transportation. Modelling the transport technology. Network simulation. Consideration of consequences of transportation improvements. Evaluation of transport projects and systems. Discussion of the application of analytical tools to current transportation problems.

Lectures three hours a week, fall term.

References: Recent publications

A. M. Khan

Engineering 82.535 Traffic Engineering I

The framework for planning and design of traffic systems. Basic characteristics of drivers, traffic vehicles, volumes, speed, delay, etc. Capacity determination. Accident characteristics and analysis. Parking characteristics and analysis. Traffic laws, ordinances, regulation and administration.

Lectures three hours a week, fall term.

References: Kennedy et al, *Fundamentals of Traffic Engineering ITTE* (1969)
T. M. Matson et al, *Traffic Engineering,* McGraw-Hill (1955)
Highway Capacity Manual, Special Report No. 87, HRB (1965)
Whol and Martin, *Traffic Systems Analysis for Engineers and Planners,* McGraw-Hill (1967)

J. P. Braaksma

Engineering 82.536 Highway Materials

Physical characteristics and strength evaluation of soils and aggregates in relation to highway engineering; frost action in soils; sources, manufacture

and composition of bituminous materials; evaluation of properties and characteristics of bituminous materials; soils stabilization.

Lectures three hours a week, fall term.

References: Abraham, *Asphalt and Allied Substances*
Traxler, *Asphalt — Its Composition, Properties and Uses*
Roads Research Laboratory, *Bituminous Materials in Road Construction*

D. A. Kasianchuk

Engineering 82.537 Urban Transportation

Travel characteristics and trends in urbanized areas. Basic urban transportation studies. Urban development models — an introduction. Simulation of urban travel patterns; trip generation, distribution, modal split and assignment. Unified approach to simulating urban travel patterns. Development and evaluation of urban transport systems.

Lectures three hours a week, fall term.

References: Recent publications

Lecturer to be announced

Engineering 82.538 Geometric Design

Basic geometric design concepts. Freeway design — geometric features. Interchange forms and design. Adaptability and spacing of interchanges. Design of operational flexibility on freeways. Design for operational uniformity and route continuity on freeways. Freeway network distribution system. Design for safety and aesthetic considerations.

Lectures three hours a week, winter term.

References: C.G.R.A., *Manual of Geometric Design Standards for Canadian Roads and Streets*
American Association of State Highway Officials, *A Policy on Geometric Design of Rural Highways*
J. E. Leish, *Interchange Design*

J. P. Braaksma

Engineering 82.539 Transportation Planning II

A critical review of transportation planning techniques and related methodologies. Economic theory application to problems involved in the planning and evaluation of transport systems; cost analysis, pricing of transportation services, consumer preference, subsidy and regulation policy analysis, the investment decision analysis, utility theory, analysis of uncertainty.

Lectures three hours a week, winter term.

References: Recent publications

A. M. Khan

Engineering 82.540 Traffic Engineering II

Theoretical techniques for describing traffic flow; empirical studies, hydro-dynamic analogy, car-following concept, probabilistic description of traffic flow, queuing of traffic. Simulation in traffic engineering, surveillance and control, network analysis.

Lectures three hours a week, winter term.

References: D. Drew, *Traffic Flow Theory and Control*
McGraw-Hill (1968)
M. Wohl and B. Martin, *Traffic Systems Analysis for Engineers and Planners,* McGraw-Hill (1967)

Peter Tan

Engineering 82.541 Ground Transportation Systems and Vehicles

Off-road transportation systems: techniques and instrumentation for evaluating terrain properties; basic terrain-vehicle relationships; economy and efficiency of cross-country transport. Characteristics of highway vehicles: criteria of vehicle performance; general theory of directional control and stability; vehicle design and safety. High speed ground transportation systems: air cushion vehicle technology; rail transit systems.

Lectures three hours a week, winter term.

References: Bekker, *Introduction to Terrain-Vehicle Systems*
Ellis, *Vehicle Dynamics*
Elsley and Devereux, *Hovercraft Design and Construction*
Hennes and Ekse, *Fundamentals of Transportation Engineering*

J. Y. Wong

Engineering 82.550 Advanced Vibration Analysis

General theory of discrete, undamped, multi-degree-of-freedom systems; normal modes; free and forced vibration by modal analysis. Modelling of continuous systems; Rayleigh-Ritz method; introduction to the finite element method; applications to bars and plates. Transfer matrices; the Holzer and Myklestad-Prohl methods. Damping; proportional and non-proportional damping; modal analysis with proportional damping. Selected applications; suspension of a rigid body; vibrations of rotating machinery including blades, discs, and shafts; multi-storey building vibration; aircraft vibration.

Lectures three hours a week, fall term.

Reference: Hurty and Rubinstein, *Dynamics of Structures*

J. Kirkhope

Engineering 82.561 Design Theory and Practice

This course is intended to give the student a deeper understanding of the design process and thereby increase his effectiveness. The emphasis will be on philosophy of comprehensive design, attitude and viewpoints of the designer, techniques of analysis, synthesis and evaluation. The creative process and the non-technical inputs and methodologies necessary to achieve the design objective will be discussed.

Lectures three hours per week, spring term.

Text: To be announced

G. Kardos

Engineering 82.562 Failure Prevention

The design properties of materials will be examined. The emphasis will be on the influence of real properties on design and on how they can be used to predict performance. Typical subjects discussed will be: physics of metals, theories of failure, reliability, plasticity, fatigue, anisotropic and composite materials, fracture mechanics, friction wear, corrosion.

Lectures three hours per week, fall term.

Text: McClintock and Argon, *Mechanical Behaviour of Materials*

G. Kardos

Engineering 82.563 Computer-Aided Design of Building Structures

Relevant aspects of computer systems, information handling, auxiliary storage; design methods, computerized design systems; computer graphics; application of structural theory; examination of a selected series of structural engineering programs and programming systems including some of the Canadian Institute of Steel Construction and Portland Cement Association programs, the ICES system and the GENESYS system.

Lectures three hours a week, winter term.

W. Wright

Not offered 1973-74

Engineering 88.513 Structural Dynamics and Aeroelasticity

Review of string and beam vibrations. Vibrations of membranes and plates. Theory of normal modes and solution by normal mode expansions. Fourier transform methods. Matrix methods and finite element techniques. Vibration of built-up bodies, multi-bay panels, complete aircraft. Introduction to flutter, wing divergence, classical wing flutter, panel flutter.

Lectures three hours a week, fall term.

References: Hurty and Rubenstein, *Dynamics of Structures*
Biggs, *Structural Dynamics*
Fung, *Theory of Aeroelasticity*

Not offered 1973-74

Engineering 97.572 Deformation of Materials

Mechanical materials testing: tensile, compression, torsion, hardness, impact, fatigue, creep and stress rupture. Elastic deformation and anelasticity; plastic deformation and dislocations. The Bauschinger effect and preferred orientation. Fracture in ductile and brittle materials. The mechanical properties of metals and alloys, ceramics, concretes, composites, polymers and graphite.

Lectures three hours a week, winter term.

References: Hayden et al, *The Structure and Properties of Materials Vol. III, Mechanical Behaviour*
Deiter, *Mechanical Metallurgy*

M. J. Bibby

Engineering 99.596 Directed Studies

Engineering 99.599 M.Eng. Thesis

Engineering 99.699 Ph.D. Thesis

SYSTEMS ENGINEERING

Chairman of the Division: J. S. Riordon

The Division of Systems Engineering offers programs of study and research leading to the Master's and Ph.D. degrees in Electrical Engineering and Mechanical Engineering.

The Divisional program centers upon the analysis and design of systems whose primary function is the processing of information and signals. Within this context, four interrelated areas of study receive major attention:

- Communications and Signal Processing
- Decision and Control
- Digital Systems Design
- Software Engineering

An integrated course program gives students some familiarity with each area, and allows specialization in one or more of them as desired. The research program emphasizes the development and application of modern methods of systems engineering pertinent to these areas. Work undertaken includes both theoretical studies of optimal systems, and the related problems of obtaining practicable realizations. Specific research topics are usually associated with one or more major goal-oriented cooperative projects. Examples of such projects now in progress include studies of the Wired Scientific City, a general approach to speech processing, and adaptive computer control of biochemical processes.

Computing systems play a substantial role in this activity. In addition to the interactive time-sharing terminals linked to the University's two Sigma 9 digital computers, the Division has available a hybrid computer facility (EAI580/PDP-15) with interactive graphics capability. Applications include digital simulation of information systems, physical measurements, modelling and process identification, hybrid simulation, on-line process and system control, signal processing, and computer aided design.

Full advantage is taken within the Division of the technology-oriented government/industry/university complex in the Ottawa region that presents a unique opportunity in Canada. Cooperative research and development projects exist between the Division of Systems Engineering and the Department of Communications, Communication Research Centre, National Research Council, Ottawa Civic Hospital, Bell-Northern Research Laboratories, University of Ottawa, Department of Energy, Mines and Resources and the Canada Post Office.

The broad areas under investigation within the Division offer opportunities for study and research for applicants with a background and interest in electrical engineering, mechanical engineering, computer science, mathematics, operations research, and management science.

GRADUATE COURSES

Note:

M.Eng students in Systems Engineering are required to complete:
  - a) at least two of 94.550, 94.552, 94.553;
  - b) no more than two of 94.501, 94.502, 94.504, 94.505.

Engineering 94.501 Simulation and Modelling

This course introduces the concept of simulation of both continuous and discrete processes, with emphasis on the latter. Model building for engineering, economic and sociological systems. Continuous time systems: analogue models, digital approximations; continuous simulation languages. Simulation of discrete event-oriented processes. Specialized simulation languages: GPSS, SIMSCRIPT, GASP, SIMPAC. Monte Carlo methods. Experimental design and statistical analysis of results.

Lectures three hours a week, fall term.

Reference: Emshoff, Sisson, *Computer Simulation*

C. M. Woodside

Engineering 94.502 Systems Feasibility and Design

Introduction to the basic techniques employed in planning and design of complex systems. User requirements. System design variables. Interaction of subsystems. Use of simulation, cost, performance, and time tradeoff. Elements of project management. Methods and approaches will be illustrated through case studies, primarily in the field of information systems engineering.

Lectures three hours a week, winter term.

Lecturer to be announced

Engineering 94.504 Computer Methods in Industrial Engineering

Linear programming. Simplex method. Duality, Network models and algorithms. Critical path method, PERT. Probabilistic decision models. Subjective probability, utility. Markov chains; dynamic programming. Recursive Bayes estimation. Queueing and inventory models.

Lectures three hours a week, fall term.

References: Wagner, *Principles of Operations Research*
Gue, Thomas, *Mathematical Methods in Operations Research*

Not offered 1973-74

Engineering 94.505 Optimization Methods

An introduction to the theory and application of computer-oriented optimization methods in engineering problems. Direct methods: steepest descent, Newton-Raphson, conjugate gradient, Powell-Zangwill. Nonlinear pro-

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gramming. Kuhn-Tucker conditions. Linear programming, duality theory. Dynamic programming. Examples from various fields of engineering.

Lectures three hours per week, winter term.

References: Kowalik and Osborne, *Methods for Unconstrained Optimization Problems*
Wilde and Beightler, *Foundations of Optimization*

Lecturer to be announced

Engineering 94.515 Socio-Economic System Models

The mathematical structure and properties of models used to describe social and economic systems. Input-output models, dynamic models of the economy, control of these models, econometric models, uncertainty in models and data. Models of population movement and traffic flow.

Prerequisites: Engineering 94.552 and 94.553.

Lectures three hours per week, winter term.

Reference: Allen, *Macro-Economic Theory*

C. M. Woodside

Engineering 94.516 Theory of Large Systems and Networks

Examples of networks and a description of engineering problems in their design and analysis. Elements of queueing theory and its application to network problems. Theory of networks and graphs; reliability; simulation; optimization. Application of methods and theories to engineering problems.

Prerequisites: Engineering 94.521, 94.552 and 94.553.

Lectures three hours a week, winter term.

Not offered 1973-74

Engineering 94.521 Communications/Computer Networks

Description of CATV systems, telephone systems, switched broadband systems including historical evolution. Switching, storage, transmission, terminals, treatment of errors, conversations with computers. Analog and digital systems and signals; format problems; interconnection. Discussion of current major engineering problem areas. Methods for the design, analysis and optimization of communications networks. Possible future developments and their implications.

Lectures three hours a week, fall term.

J. de Mercado

Engineering 94.524 Communication-Computer System Architecture

Application of mathematical techniques in optimization and in queueing theory to problems in the design of communication-computer systems, including switching and multiplexing, choice of data rates and block sizes, memory management strategies, scheduling algorithms, dynamic file allocation and system reliability.

Prerequisites: Engineering 94.552, 94.553, 94.521.

Lectures three hours a week, winter term.

J. de Mercado

Engineering 94.539 Advanced Topics in Digital Systems Design

A course dealing with recent and advanced topics in the field of digital systems design and related areas. Primary references are recent publications in the field. Students registered in the course are expected to present one or more lectures or seminars on assigned topics.

Prerequisites: Engineering 94.557, 94.558 and permission of the instructor.

Lectures and seminars three hours a week, one term.

R. J. A. Buhr

Engineering 94.545 Adaptive Control Systems

Recursive estimation of parameters and state. Dual control. Separation theorems. Examples of adaptive systems: model reference systems, adaptation based on pulse response, discrete state stochastic systems.

Prerequisites: Engineering 94.552, 94.553 and 94.555.

Lectures three hours a week, winter term.

References: Eveleigh, *Adaptive Control and Optimization Techniques*
                 IEEE Transactions on Automatic Control

J. S. Riordon

Engineering 94.550 Introduction to Basic Software Engineering

Introduction to the software engineering viewpoint: the application of the principles of software organization to the design and production of software, to specification, within an economic and time framework. Types of software; relationship to hardware; importance of structural aspects. Data structures; searching and manipulation; table driven methods. Run-time program structures; separation of procedure and data objects; reentrancy and recursion; vertical and horizontal modularity; module interfaces. Programming languages: features, syntax. semantics and translation. Extensible languages and translator writing systems. Structured programming. Generality/complexity· tradeoffs. Software specification and production; project control. A significant aspect of the course is a group project to implement a modularized software system.

Prerequisites: Permission of the instructors. Normally, students should have significant programming experience in at least one language and some appreciation of the basic concepts of Computing Science.

Lectures three hours a week, fall term.

References: Selected references from such sources as *Journal of Software Practice and Experience, Communications of the ACM, Computing Surveys,* Proceedings of the 1968 and 1969 NATO Conferences on *Software Engineering*

R. J. A. Buhr and W. R. Bezanson

Engineering 94.551 Estimation Theory

Markov processes. Decision theory; hypothesis testing, minimum risk estimators, maximum likelihood estimators, Bayesian estimation. Parameter estimation; least square and maximum likelihood. Review of linear filtering; recursive techniques. Wiener-Kalman filters. Examples from the fields of communications and control.

Prerequisites: Engineering 94.552 and 94.553.

Lectures three hours a week, winter term.

Lecturer to be announced

Engineering 94.552 Advanced Linear Systems

Mathematical techniques used in the analysis of linear systems. Vector space and function space techniques. Review of analysis by transform methods using the Fourier transform. General relationship between time and frequency functions. Band-pass/low pass transformations. Causal functions and the Hilbert transform. The sampling Theorem and general orthonormal expansions. Analysis of linear time-invariant and time-varying systems using State-space methods. Controllable and observable systems. Discrete time linear systems.

Lectures three hours a week, fall term.

References: Papoulis, *The Fourier Integral and its Applications*
DeRusso, Roy and Close, *State Variables for Engineers*

Lecturer to be announced

Engineering 94.553 Stochastic Processes

Basic concepts of probability theory. Random variables; distribution and density functions, functions of a random variable, averages, moments, characteristic functions, sequences, introduction to statistical estimation. Random signals in linear systems; power measurement, correlation, spectral analysis. Elements of queueing theory; arrival distributions, service policies, waiting times, Markov sequences, system models.

Lectures three hours a week, fall term.

References: Papoulis, *Probability, Random Variables, and Stochastic Processes*
Thomas, *An Introduction to Statistical Communication Theory*
Beckmann, *Probability in Communication Engineering*

L. R. Morris

Engineering 94.554 Statistical Communication Theory

Complex envelope description of bandpass signals and random processes. Analog communication systems; receiver structure, noise and bandwidth properties of AM and angle modulation. Digital communication systems; basic decision theory, common signal sets, receiver structure and white noise error probability. Channel models; channel filter, colored noise

random gain, random phase. Elective portion; topics selected from equalizers, radar, PCM, scatter transmission or others.

Prerequisites: Engineering 94.552 and 94.553.

Lectures three hours a week, winter term.

References: Schwartz, Bennett and Stein, *Communication Systems and Techniques*
Wozencraft and Jacobs, *Principles of Communication Engineering*

J. K. Cavers

Engineering 94.555 Digital Control System Design

Design of computer control algorithms and systems. Review of basic discrete-system theory; sampling and the z-transform; properties of discrete-time systems; unstable and non-minimum phase systems. Control algorithm design: performance specifications; feedforward and feedback approaches; PID, deadbeat, minimum settling time and minimum variance algorithms; problems with reset windup, interactions, non-linearities, modelling errors; approximate implementation of continuous time algorithms. System design for computer control: architectural and functional possibilities for computer control systems; stages in implementation; cost factors. Economic effects of computer control. Case studies.

Lectures three hours a week, fall term.

References: Cadzow and Martens, *Discrete Time and Computer Control Systems*
Stout, *Where are Process Computers Justified?*

R. J. A. Buhr

Engineering 94.556 Advanced Stochastic Processes

Definition of a stochastic process. Wiener process, Levy's theorem, their relation to white and broadband noise. Poisson process. Processes with independent increments, process with uncorrelated or orthoganal increments. Markov processes, Chapman-Kolmogoroff equation, Fokker-Planck equations. Modelling physical processes. The stochastic integral and diffusion equations. Least square estimator; Wiener-Kalman filter, linear smoothing filter, selected non-linear estimation problems in communication and control.

Prerequisites: Engineering 94.551, 94.552 and 94.553.

Lectures three hours a week, winter term.

References: Papoulis, *Probability, Random Variables and Stochastic Processes*
Doob, *Stochastic Processes*
Current IEEE Transactions

Lecturer to be announced

Engineering 94.557 Topics in Switching Theory

A review of Boolean algebra leading to the concept of cubic array representation of multiple-input, multiple-output combinatorial logic. Study of array operators and resulting algorithms for computer-aided extraction of minimum-cost functions. Multi-level synthesis algorithms also covered. A review of standard techniques for analysis and design of sequential synchronous machines with major emphasis placed on asynchronous design methodologies. An introduction to machine architecture and a digital design language documentation leading to automated design algorithms.

Lectures three hours a week, winter term.

Reference: Dietmeyer, *Logic Design of Digital Systems*

B. A. Bowen

Engineering 94.558 Digital Machine Architecture

Detailed comparison of several small computers to illustrate architectural structure. State design representation are formulated and criteria of comparison developed. The relation of hardware to software is explored and the influence of dynamic micro-programming and read-only memory additions are covered. Function specification and macro-design techniques are then developed.

Lectures three hours a week, fall term.

References: Dietmeyer, *Logical Design of Digital Systems*

B. A. Bowen

Engineering 94.560 Advanced Engineering Application of Digital Computers

Finite difference methods, polynomial interpolation and curve fitting. Undetermined coefficients used for interpolation and integration. Integration in general. Errors using Peano's Kernel, Differential equations; predictor-corrector methods, truncation error, convergence and stability. Fourier methods; discrete Fourier transform, fast Fourier transform. Matrices, LU decomposition, scaling.

Lectures three hours a week, fall term.

References: Lanezos, *Applied Analysis*
Davis and Rabinowitz, *Numerical Integration*
Salvadori and Baron, *Numerical Methods in Engineering*

J. Knight

Engineering 94.562 Signal Processing

Sampling: sampling theorem, spectra of sampled signals, non-ideal sampling, aliasing errors, reconstruction of sample signals. Quantization: analog-digital conversion minimization of quantization errors, sampling and quantization in the presence of noise. Signal analysis: estimation of power spectra, Fourier transforms, correlation functions, and other averages, smoothing. FFT techniques. Filtering: digital and active filters. Miscellaneous topics: measurement in the presence of noise: noise sources,

balanced systems, grounding; random signal generation; special purpose processors; adaptive filters; Walsh transforms; optical processors.

Prerequisites: Engineering 94.552 and 94.553.

Lectures three hours per week, winter term.

References: Korn, *Random Process Simulation and Measurements*
Radar and Gold, *Digital Processing of Signals*

Lecturer to be announced

Engineering 94.563 Communications Technology

Current engineering practice in communications systems design. The performance and interconnection of subsystems which make up multichannel transmitters and receivers. Topics to be discussed include modulation, multiplexing, solid state microwave signal sources and amplifiers, transmission systems, and receivers.

Prerequisites: Engineering 94.552 and 94.553.

Lectures three hours a week, winter term.

D. R. Conn

Engineering 94.565 Digital Communications

Channel characteristics: frequency response, attenuation, noise. Synchronous and asynchronous transmission, modems. Reduction of channel distortion by equalizing and precoding. Synchronization techniques and error control. Multiplexers and concentrators: elementary traffic equations, buffer size, transmission delay. Line control: polling, response time. Data loops: slot allocation schemes, response time.

Prerequisite: Engineering 94.554 (may be taken concurrently).

Lectures three hours a week, winter term.

References: D. R. Cox and W. L. Smith, *Queues*
J. W. Martin, *Teleprocessing Network Organization*
Assorted Tutorial Papers

Lecturer to be announced

Engineering 94.566 Advanced Topics in Control Systems

A course dealing with recent and advanced topics in the field of control systems and related areas. Primary references are recent publications in the field. Students registered in the course are expected to present one or more lectures or seminars on assigned topics.

Prerequisites: Engineering 94.545 or 94.585 and permission of the instructor.

Lectures and seminars three hours a week, one term.

J. S. Riordon and C. M. Woodside

Engineering 94.571 Real-time Computer System Design

Characteristics of on-line systems. Hardware requirements. Design guidelines. Design calculation. Statistics and performance measurement. Application program organization. Comparison of systems and languages for application programs. File organization; simultaneous access; file security; file recovery. On-line operating systems: executive; scheduler; input/output; memory management; recovery. Testing and debugging. Examples and case studies will be used throughout from the fields of on-line information retrieval, process control, data acquisition and teleprocessing.

Prerequisite: Engineering 94.550.

Lectures three hours a week, winter term.

Reference: Yourdon, *Design of On-line Computer Systems*

R. J. A. Buhr and W. R. Bezanson

Engineering 94.579 Advanced Topics in Software Engineering

A course dealing with recent and advanced topics in the field of software engineering and related areas. Primary references are recent publications in the field. Students registered in the course are expected to present one or more lectures or seminars on assigned topics.

Prerequisites: Engineering 94.571 and permission of the instructor.

Lecture three hours a week, one term.

B. A. Bowen

Engineering 94.584 Advanced Topics in Communications Systems

A course dealing with recent and advanced topics in the field of communication systems and related areas. Primary references are recent publications in the field. Students registered in the course are expected to present one or more lectures or seminars on assigned topics.

Prerequisites: Engineering 94.565 and permission of the instructor.

Lectures and seminars three hours a week, one term.

D. A. George

Engineering 94.585 Time-Varying and Optimal Control Systems

State-space methods applied to time-invariant and time-varying systems. The calculus of variations. The Maximum Principle of Pontryagin. On-off systems. Dynamic programming. Iterative optimization techniques. The Kalman filter and the Duality Principle.

Prerequisites: Engineering 94.552 and 94.553.

Lectures three hours a week, winter term.

References: Sage, *Optimum Control Systems*
              De Russo, Roy and Close, *State Variables for Engineers*
              Athans and Falb, *Optimal Control*

Lecturer to be announced

Engineering 99.596 Directed Studies

Engineering 99.599 M.Eng. Thesis

Engineering 99.699 Ph.D. Thesis

Other engineering courses of particular interest to students in Systems Engineering include:

Aerothermodynamics
   88.511 Dynamics and Aerodynamics of Low-Speed Flight

Electronics and Materials Engineering
   97.555 Passive Circuit Theory
   97.557 Active Circuit Theory
   97.580 Theory of Semiconductor Devices
   97.582 Coherent Electromagnetic Theory and Optics
   97.586 Computer Aided Circuit Design

Solid Mechanics and Structural Engineering
   82.534 Transportation Planning I
   82.535 Traffic Engineering I
   82.537 Urban Transportation
   82.541 Ground Transportation Systems and Vehicles

DEPARTMENTAL PROGRAM DESCRIPTIONS
AND DETAILS OF COURSES

SCIENCE

Biology
Chemistry
Geology
Mathematics
Physics

BIOLOGY

Chairman of the Department: J. M. Neelin
Associate Chairman, Graduate Studies: V. N. Iyer

The Department of Biology offers programs of study and research lead-ing to the M.Sc. and Ph.D. degrees. The research activities of the faculty members of the Department are currently directed to three major areas:

Molecular and Developmental Biology
T. W. Betz, V. N. Iyer, P. E. Lee,
M. McCully, J. M. Neelin, G. Setterfield, H. Yamazaki

Physiology
D. R. Gardner, S. L. Jacobson, K. W. Joy, J. Sinclair,
J. A. Webb, F. Wightman

Ecology and Systematics
C. A. Barlow, I. Bayly, G. R. Carmody, M. B. Fenton,
H. F. Howden, W. I. Illman, J. D. H. Lambert,
H. G. Merriam, H. H. J. Nesbitt, D. A. Smith

The Department welcomes applications from graduates with degrees in Biology, Botany or Zoology. However, since current trends indicate that students in the non-biological sciences (Chemistry, Engineering, Mathe-matics, Physics, Psychology, etc.) may also be suited to undertake valuable research and graduate work in Biology, the Department encourages graduates in other scientific disciplines to apply. If admitted, such students will normally take additional courses in Biology to make up deficiencies in their background; the completion of these extra courses will generally not require more than one additional year of study.

The Department of Biology has co-operative agreements with the National Research Council, the Research Branch of the Canada Department of Agriculture, and the National Museum of Natural Sciences in Ottawa whereby scientists from these institutions may assist graduate students with particular research projects, subject to the approval of the departments concerned.

The studies of each graduate student will be supervised by an Advisory Committee consisting of his research supervisor and two other advisors.

QUALIFYING YEAR PROGRAM
Candidates who lack the minimum qualifications for admission to the Master's program must register in and successfully complete a Qualifying Year program. Refer to the general section of this Calendar for details of the regulations governing the Qualifying Year.

MASTER OF SCIENCE
Admission Requirements
The minimum requirements for admission to the Master's program are outlined in the general regulations section of this Calendar.

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Program Requirements

The candidate will complete five approved full-courses (or the equivalent) including a research thesis equivalent to a maximum of two full-course credits. The thesis must be successfully defended at an oral examination.

All candidates are also expected to attend and contribute to regular departmental research seminars, and may be required to demonstrate a reading knowledge of one language other than English and to take certain technical or other courses.

DOCTOR OF PHILOSOPHY
Admission Requirements

Applicants holding an M.Sc. degree from a recognized university will be considered for admission into the Ph.D. program.

An applicant with an Honours bachelor's degree who has achieved an outstanding academic record and, in addition, exhibits very strong motivation and high promise for advanced research, may be admitted to the Ph.D. program directly. Such candidates will be required to complete at least 15 full-courses, or the equivalent.

Students who have been admitted to the Master's program may be permitted to transfer into the Ph.D. program if they show outstanding academic performance and demonstrate high promise for advanced research during the first year of the Master's program.

Program Requirements

Over a period of two years or more, the candidate must complete the following:

- Ten full-courses, or the equivalent.
- An oral comprehensive examination, which must be undertaken not later than one year before submission of the Ph.D. thesis.
- A research thesis equivalent to a maximum of seven of the required ten full-course credits. The thesis must be successfully defended at an oral examination.

All candidates are also expected to attend and contribute to regular departmental research seminars, and may be required to demonstrate a reading knowledge of one or two languages other than English and to take certain technical or other courses.

Students who have been admitted to the Ph.D. program on the basis of a 15-course requirement, which will normally require three years of full-time study, must complete the following:

- Fifteen full courses, or the equivalent.
- A comprehensive examination.
- A research thesis equivalent to a maximum of eight of the 15-course requirement.
- The language requirement outlined above.

GRADUATE COURSES

Biology 61.500 Current Developments in Molecular Genetics
Discussion of recent experimental approaches, ideas and findings on a selected focal topic or topics germane to current development(s) in molecular genetics. In a given year, guest lecturers from the University of Ottawa, the National Research Council or the Government Departments of Agriculture and National Health and Welfare may contribute from their areas of specialization. Students are encouraged to consult with the instructor to determine the focal topic(s) in a given year.
Weekly seminars and lectures, fall and winter terms.
Prerequisite: Permission of instructor.
V. N. Iyer and H. Yamazaki

Biology 61.502 Regulations of Macromolecular Biosynthesis
A study of molecular mechanisms involved in the regulation of protein and nucleic acid biosynthesis.
Weekly seminars and problems, fall and winter terms.
Prerequisite: Permission of instructor.
H. Yamazaki
Not offered 1973-74

Biology 61.505 Virology
Transmission of viruses by arthropods, the purification of viruses and their relationship to host cells.
Lectures two hours a week, laboratory four hours a week, fall and winter terms.
Prerequisites: Biochemistry 63.300 and permission of instructor.
P. E. Lee

Biology 61.510 Advanced Plant Morphogenesis
An advanced course dealing with selected topics in Plant Morphogenesis.
Lectures two hours a week, laboratory four hours a week, fall and winter terms.
Prerequisite: Permission of instructor.
Margaret McCully

Biology 61.520 Advanced Cell Biology
A lecture and seminar course dealing with recent developments in the study of virus and cell structure and function at microscopic and molecular levels. In a given year, selected topics in cell biology will be covered in depth. The course is often offered jointly with the Biology Department, University of Ottawa. In addition to the regular professors, specialist guest lecturers from local government laboratories are frequent contributors.
Lectures and seminars two hours a week, fall and winter terms.
Prerequisite: Biology 61.420 or equivalent.
G. Setterfield, P. E. Lee, J. M. Neelin
Not offered 1973-74

Biology 61.525 Plant Physiology
An advanced course in plant physiology.
Prerequisite: Biology 61.425 or permission of the instructors.
J. A. Webb, F. Wightman, and K. W. Joy

Biology 61.530 Plant Biochemistry
An advanced course covering selected topics in plant biochemistry.
Seminar two hours a week, fall and winter terms.
Prerequisite: Biology 61.425 or permission of the instructors.
K. W. Joy and F. Wightman

Biology 61.535 Special Studies in Physiology
A course dealing with some of the recent advances in physiology.
Lectures and seminars two hours a week, fall and winter terms.
Prerequisite: Permission of the instructors.
D. R. Gardner, S. L. Jacobson and J. Sinclair

Biology 61.542 Endocrinology
An experimental analysis of basic endocrinology, neuroendocrinology and
modes of hormone action in vertebrates.
Lectures and seminars three hours a week, fall and winter terms.
Prerequisite: Biology 61.340 and permission of the instructor.
H. Robertson
Not offered 1973-74

Biology 61.550 Selected Topics
Courses in selected aspects of specialized biological subjects not covered
by other graduate courses may be offered. Course details will be available
at Registration.
Lectures and seminars three hours a week, fall and winter terms.
Prerequisite: Permission of the Department.
Members of the Department and invited lecturers

Biology 61.551 Advanced Topics
Courses in selected aspects of specialized biological subjects not covered by
other graduate courses. Course details will be available at Registration.
Lectures and seminar three hours a week, fall and winter terms.
Members of the Department and invited lecturers

Biology 61.552 Graduate Seminar
A mandatory seminar course to encourage graduate students in different
specialties to retain a broader perspective of biology. To achieve this,
seminars and vigorous discussion will be guided by successive groups of
faculty members representing the areas of interest in the Department.
Seminars two hours a week, fall and winter terms.
Members of the Department

Biology 61.555 Advanced Insect Morphology
A course devoted to an advanced study of insect morphology and phylogeny.
Lectures and seminars two hours a week, fall and winter terms.
Prerequisite: Biology 61.460.
H. H. J. Nesbitt

Biology 61.556 Advanced Insect Taxonomy
A course devoted to an advanced study of insect taxonomy.
Prerequisite: Biology 61.460.
H. F. Howden and H. H. J. Nesbitt

Biology 61.557 Acarology
An advanced course devoted to the Acari (mites).
Prerequisite: Biology 61.460.
Lectures two hours a week, fall and winter terms.
H. H. J. Nesbitt

Biology 61.560 Plant Ecology
A course covering selected topics in plant ecology.
Seminars three hours a week, fall and winter terms.
Prerequisite: Permission of the instructors.
Isabel Bayly and J. D. H. Lambert

Biology 61.570 Evolution and Biogeography
Lectures two hours and laboratory four hours a week, fall and winter terms.
Prerequisite: Permission of the instructor.
H. F. Howden

Biology 61.575 Mammalogy
A lecture, seminar, and laboratory course on the taxonomy, distribution, behaviour, and ecology of mammals.
Seminar two hours and laboratory four hours a week, fall and winter terms.
Prerequisites: Biology 61.360 and 61.415, or permission of the instructor.
D. A. Smith

Biology 61.580 Plant Taxonomy
Lectures and seminars three hours a week, fall and winter terms.
Prerequisite: Biology 61.440.
Isabel Bayly

Biology 61.585 Mycology
An advanced course devoted to the morphology, reproduction, taxonomy, and evolution of the fungi.
Prerequisite: Biology 61.401.
W. I. Illman

Biology 61.590 Directed Special Studies and Research

Seminars, research tutorials and/or lectures three hours a week, fall and winter terms.

Prerequisite: Permission of the Department.

Members of the Department

Biology 61.599 M.Sc. Thesis

Biology 61.699 Ph.D. Thesis

CHEMISTRY

Chairman of the Department: J. W. ApSimon
Supervisor of Graduate Studies: D. R. Wiles

The Department of Chemistry offers opportunities for advanced study and research leading to the degrees of M.Sc. and Ph.D.

The research interests of the faculty members are currently directed to the following areas:

Organic and Biochemistry

J. W. ApSimon, G. W. Buchanan, P. M. Laughton, C. S. Tsai, D. C. Wigfield, R. H. Wightman, J. S. Wright.

Surface and Solid State Chemistry

C. H. Amberg, R. G. Barradas, J. M. Holmes, J. A. Koningstein, R. A. Shigeishi, D. R. Wiles.

Liquids and Solutions

R. G. Barradas, C. L. Chakrabarti, P. Kruus, C. H. Langford, P. M. Laughton, M. Parris, D. C. Wigfield.

Spectroscopic and Theoretical Studies

J. W. ApSimon, G. W. Buchanan, C. L. Chakrabarti, J. A. Koningstein, P. Kruus, M. Parris, D. R. Wiles, J. S. Wright.

For additional information regarding these areas of research or any other aspect of graduate work in Chemistry, write to the Chairman of the Department.

MASTER OF SCIENCE

Admission Requirements

The normal requirement for admission to the Master's program is an Honours B.Sc. degree in Chemistry with at least high second-class standing. Candidates who do not qualify for direct admission into the Master's program may be accepted into a Qualifying Year program as specified in the general regulations section of this Calendar.

Preparation in the fields of Mathematics and Physics is also required.

Applicants may be required to write the Graduate Record Examinations (scores are to be submitted at the time of application).

Program Requirements

The specific program requirements in the Department of Chemistry are the following:

- Three full-courses, or the equivalent.
- A research thesis, which must be defended at a final oral examination.

- A reading knowledge of two languages other than English, normally chosen from French, German, and Russian.

Additional preparatory courses may be recommended if deemed necessary at the time of registration.

DOCTOR OF PHILOSOPHY

Admission Requirements

Ordinarily, an M.Sc. degree (or the equivalent) from a recognized university is required for admission to the Ph.D. program. This program consists of the equivalent of ten full course credits.

An applicant with an Honours B.Sc. degree in Chemistry who has achieved an outstanding academic record and, in addition, exhibits very strong motivation and high promise for advanced research, may be admitted to the Ph.D. program directly. Such candidates will be required to complete the equivalent of at least 15 full-courses.

Applicants may be required to write the Graduate Record Examinations (scores are to be submitted at the time of application).

Program Requirements

The normal requirements in the Ph.D. program are the following:

- A minimum of two years of full-time study and research.
- Three full-courses (or the equivalent) at the graduate level.
- Comprehensive examination in Chemistry, which will be completed approximately one year before submission of the thesis. This will normally take the form of written General Examinations in all phases of Chemistry, to be taken during the first fifteen months of Ph.D. enrolment, and a series of Cumulative Examinations in the area of specialization. These examinations are available every month during Fall and Winter terms, and the candidate must pass six out of the first eighteen papers attempted.
- A Ph.D. thesis equivalent to seven full courses.
- A reading knowledge of two languages other than English, normally chosen from French, German and Russian.

Students who have been admitted to the Ph.D. program on the basis of a 15-course requirement must complete the following:

- A minimum of seven full-courses.
- A comprehensive examination in Chemistry, as above.
- A research thesis equivalent to a maximum of eight full-courses.
- The language requirement outlined above.

This program will normally require at least three years of full-time study.

GRADUATE COURSES

Course Offerings

The Graduate course offerings of the Department are listed below. Note that a student may register for a course more than once (except for 65.509) if the topics covered are sufficiently different to constitute separate studies. Several of these courses are done in conjunction with scientists at nearby research laboratories, and with the Chemistry Department of the University of Ottawa.

Chemistry 65.509 Molecular Spectroscopy
                 (also listed as Physics 75.522)
Lectures two hours per week, winter term.
G. Herzberg and J. A. Koningstein
Next offered 1974-75

Chemistry 65.515 Fall Term, **65.516** Winter Term
   Advanced Topics in Physical Chemistry:
      —Quantum Chemistry I, II
      —Structure and Dynamics in Liquids I, II
      —Chemical Kinetics
      —Surface Chemistry and Catalysis I, II
      —Electrochemistry

Chemistry 65.525 Fall Term, **65.526** Winter Term
   Advanced Topics in Organic Chemistry:
      —Natural Products Chemistry I, II
      —Physical Organic Chemistry I, II
      —Synthetic Organic Chemistry I, II
      —Biochemistry of Enzyme Action
      —Mechanisms of Biochemical Reactions
      —Biosynthesis of Natural Products

Chemistry 65.555 Fall Term, **65.556** Winter Term
   Advanced Topics in Inorganic Chemistry
      —Analytical Spectroscopy I, II
      —Theory of Transition Metal Ions I, II
      —Chemical Effects of Nuclear Transformations
      —Reactions of Coordinated Ligands
      —Metal Ions in Solution
      —Non-aqueous Solvents
      —Non-metal Chemistry

Chemistry 65.590 Directed Special Studies

Chemistry 65.599 M.Sc. Thesis

Chemistry 65.699 Ph.D. Thesis

GEOLOGY

Chairman of Department: W. M. Tupper
Supervisors of Graduate Studies: R. L. Brown, G. Y. Chao

The Department of Geology offers programs of research and study leading to the degrees of Master of Science and Doctor of Philosophy. At the present time, the three principal fields of graduate study and research are:

Resource Geology
R. L. Borden, R. W. Boyle, P. A. Hill, F. K. North, J. A. Soles, W. M. Tupper, R. W. Yole.

Precambrian Geology
K. Bell, J. A. Donaldson, E. Irving, R. K. Herd, J. M. Moore, G. B. Skippen, D. H. Watkinson.

Structure and Geodynamics
R. L. Brown, G. Ranalli.

The current research fields in the Department include: applied geochemistry, mineral deposits, petroleum geology, experimental mineralogy, geochemistry, geochronology, metamorphic petrology, sedimentology and stratigraphy, structural analysis and geodynamics, crytallography (G. Y. Chao) and micropalaeontology (K. Hooper).

QUALIFYING YEAR PROGRAM

Applicants with a general (pass) bachelor's degree may be admitted to a Qualifying Year program designed to raise their standing to the Honours level. Refer to the general section of this Calendar for details of the regulations governing the Qualifying Year.

MASTER OF SCIENCE

Admission Requirements

The normal requirement for admission to the Master's program is an Honours bachelor's degree, with at least second class standing, in Geology or a related discipline.

Program Requirements

Students entering from another university will be required to write, at the time of initial registration, an orientation examination in geology and related sciences. This examination will assist in determining whether or not the candidate has deficiencies in areas related to his program.

In addition to the general program requirements of the Faculty of Graduate Studies, candidates in Geology must complete the following:

- **Geology 67.501, 502,** a compulsory seminar.
- Two other graduate full-courses (or the equivalent) in Geology, or in certain cases, in an ancillary science at the senior undergraduate level.

- Additional non-credit courses, if recommended by the candidate's advisory committee.
- A reading knowledge of an approved language other than English, relevant to the candidate's field of research.
- A thesis based on the student's own research which must be defended at an oral examination.

DOCTOR OF PHILOSOPHY

Admission Requirements

The minimum requirements for admission to the Doctoral program are outlined in the general regulations section of this Calendar. The normal requirement is an M.Sc. in Geology or a related discipline.

Students who have been admitted to the Master's program may be permitted to transfer into the Ph.D. program if they show outstanding academic performance and demonstrate significant promise for advanced research during the first year of the Master's program.

Program Requirements

Candidates entering from another university will be required to write, at the time of initial registration, an orientation examination in Geology and related sciences. The results are to assist in planning the candidate's program.

The program requirements in the Department of Geology are the following:

- **Geology 67.501, 502** AND one other graduate course in Geology, AND at least one additional course in Geology or a related discipline.
- Additional formal or directed reading courses which the candidate or the advisory committee consider desirable as preparation for the comprehensive examinations.
- An oral examination in general Geology and related sciences, which will be undertaken at the end of the first year of full-time study, prior to the comprehensive examinations.
- A reading knowledge of geological subjects in an approved language other than English, relevant to the field of research. Each candidate must complete this requirement before undertaking the comprehensive examinations.
- Comprehensive examinations in two areas of specialization, one of which must be directly related to the candidate's thesis research. These examinations may be written or oral, or both.
- A thesis on an approved problem, which contributes to basic knowledge in the geological sciences or related fields. The thesis must be defended at an oral examination.

SELECTION OF COURSES

The following undergraduate courses are frequently taken by graduate students and may, with the approval of the Department of Geology, be selected by Master's candidates in partial fulfillment of their degree requirements:

Geology	**67.421**	Metallic Mineral Deposits
	67.423	Petroleum Geology
	67.431	Micropalaeontology
	67.442	Advanced Structure
	67.451	Metamorphic Petrology
	67.452	Igneous Petrology
	67.463	Sedimentology
	67.464	Precambrian Geology
	67.481	Physics of the Earth
	67.483	Applied Geochemistry
	67.488	Isotope Geology

In addition to the courses offered by the Department, graduate students in Geology may select, in partial fulfillment of their degree requirements, some of the following courses offered by the Department of Geography:

Geography	**45.510**	Channel Form and Process
	45.512	Experimental Geomorphology
	45.514	Periglacial Geomorphology
	45.516	Properties of Soils in Relation to Soil Chemistry

Through inter-university co-operation in graduate instruction, full-time graduate students registered at Carleton may arrange to enrol each year in one complementary subject offered at the University of Ottawa, including Igneous Petrology, Mineralogy, Palaeontology and Sedimentary Geochemistry.

GRADUATE COURSES

Geology 67.501, 502 Seminar

Consecutive half-courses compulsory for graduate students during the first two years of residence. Seminars are presented by graduate students and discussed by graduates and staff.

Seminar two hours per week, fall and winter term.

P. A. Hill and others

Geology 67.505 Mineral Economics

Principles of economics applied to the mineral industries. Special reference is made to the major mineral industries and to international resources, supply-demand, marketing, transportation, and financing. Economic geology of the more significant mineral industries.

Lectures three hours per week, fall and winter terms, evening.

Prerequisites: Geology 67.325 and Economics 43.100, or permission of the instructor.

Reference Text: AIMME, *Economics of the Mineral Industries*
U.S.B.M., *Mineral Facts and Problems*

R. L. Borden

Not offered 1973-74

Geology 67.515 Tectonophysics

Selected problems in structural geology, tectonics, and geodynamics, treated in seminar and laboratory sessions. In addition, students are required to investigate and report on individual projects.

Lectures and seminars three hours a week, fall and winter terms.

Prerequisites: Geology 67.385 and permission of the instructor.

Reference Texts: Ramsay, *Folding and Fracturing of Rocks*
Hart (Ed.), *The Earth's Crust and Upper Mantle*
Jaeger and Cooke, *Fundamentals of Rock Mechanics*

R. L. Brown and G. Ranalli

Not offered 1973-74

Geology 67.520 Advanced Mineral Deposits

Theories of ore deposition are examined in detail. Fields of study include metallic and industrial minerals, petroleum and natural gas. Specific examples are chosen to illustrate the features of deposits of different genetic types.

Lectures and seminars four hours a week, fall and winter terms, evening division.

Prerequisite: Geology 67.325

Reference Texts: Bates, *Geology of Industrial Rocks and Minerals*
USBM, *Mineral Facts and Problems*

J. A. Soles

Geology 67.525 Advanced Crystallography

Principles and techniques of X-ray crystallography; interpretation of X-ray photographs and application to the study of minerals.

Lectures and laboratory six hours a week, fall and winter terms.

Prerequisites: Geology 67.221, 67.222

Reference Texts: To be announced.

G. Y. Chao

Geology 67.531, 532 Advanced Palaeontology

The morphology, classification, palaeoecology and geological history of one or more faunal or floral fossil groups. Normally the course stresses microfauna and microflora such as Foraminifera, Ostracoda, conodonts, spores, pollen and acritarchs, but macrofossils may also be included.

Seminar and laboratory five hours a week, 531 fall term, 532 winter term.

Prerequisites: Geology 67.335, Geology 67.431 may be taken concurrently. Biology 61.360 is recommended.

K. Hooper

Geology 67.545 Glaciology

The flow and temperature regimes of glaciers and ice sheets, the classification and growth of lake and river ice, the behavior of ice under load, the diagenesis of snow and melt processes.

Lectures three hours a week, fall and winter terms, evening division.

Reference Text: Paterson, *Physics of Glaciers*

A. D. Stanley and others

Geology 67.550 Advanced Petrology

Interpretation of metamorphic and igneous rocks, with emphasis on phase equilibria.

Seminars and laboratory five hours a week, fall and winter terms.

Prerequisites: Chemistry 65.210, Geology 67.451, and 67.452

Reference Text: Wylie, *The Dynamic Earth*

R. K. Herd

Geology 67.560 Stratigraphy and Sedimentology

Selected problems in sedimentary geology. The application of modern techniques of stratigraphic, petrologic and statistical analysis.

Seminars and laboratory five hours a week, fall and winter terms.

Prerequisites: Geology 67.325, 67.335, 67.463.

Reference Texts: Bathurst, *Carbonate Sediments and their Diagenesis*
Pettijohn and Potter, *Sand and Sandstones*
Griffiths, *Scientific Method in Analysis of Sediments*

R. W. Yole and J. A. Donaldson

Geology 67.562 Precambrian Geology I

Problems of Precambrian geology, emphasizing classical and current studies in North America. Laboratory, research methods, field trips, and petrologic studies of representative rock suites. Students are required to attend lectures in Geology 67.463 and to perform additional research work which will be discussed in seminar sessions.

Lectures and laboratory five hours a week, winter term.

Prerequisite: One of Geology 67.451, 67.452, 67.463 (may be taken concurrently).

J. A. Donaldson

Geology 67.563 Precambrian Geology II
Review and discussion of recent literature on Precambrian geology. Comparative study of the Canadian Shield and other Precambrian Shields.
Seminars and laboratory five hours a week, fall term.
Prerequisite: Geology 67.562 or permission of Department.
J. A. Donaldson; other members of Department and invited speakers

Geology 67.580 Advanced Inorganic Geochemistry
The geochemical classification of the elements; abundance of the elements; periodic table; bonding; hydrolysis; complex ions; colloids; oxidation-reduction; metamorphism; diffusion; isotopes; metallic mineral deposits.
Lectures and seminars three hours a week, fall and winter terms, evening division.
Prerequisites: Geology 67.325, Chemistry 65.250.
R. W. Boyle
Not offered 1973-74

Geology 67.583 Physics of the Earth
The physics and dynamics of the solid Earth. Gravitational and geomagnetic fields; continuum mechanics and seismology; heat flow and thermal state of the interior. Students are required to attend classes in Geology 67.481 and to perform additional research work which will be presented and discussed in seminar sessions.
Lectures and laboratories five hours a week, fall term.
Prerequisites: Geology 67.325, Geology 67.385, or permission of the instructor.
Texts: Stacey, *Physics of the Earth*
Hart (Ed.), *The Earth's Crust and Upper Mantle*
Bott, *The Interior of the Earth*
G. Ranalli

Geology 67.585 Physical Geochemistry
Application of thermodynamics to geologic problems. Experimental study of mineral equilibria.
Lectures three hours a week, fall and winter terms.
Prerequisites: Chemistry 65.210, Geology 67.451.
Reference Texts: Callen, *Thermodynamics*
Korzhinskii, *The Physiochemical Basis of the Analysis of the Paragenesis of Minerals*
G. B. Skippen

Geology 67.591, 67.592 Directed Studies
Directed reading or directed laboratory studies under the guidance of selected extramural or intramural directors.

Geology 67.599 M.Sc. Thesis

Geology 67.699 Ph.D. Thesis

MATHEMATICS

Chairman of the Department: V. Dlab
Supervisor of Graduate Studies: D. A. Dawson

The Department of Mathematics offers graduate programs leading to the M.Sc. degree with specialization in Pure Mathematics, Applied Mathematics, and Statistics; and the Ph.D. degree with specialization in Pure Mathematics and Applied Mathematics. The principal research interests of the faculty include the following fields:

Pure Mathematics

Algebra: group theory; theory of rings and modules; representation theory; universal algebra; ordered structures; homological algebra; categories; commutative algebra.

Analysis: inequalities; summability; generalized integral transform; functional analysis; function spaces and algebras; operator theory; measure theory; potential theory; rings of continuous functions.

Geometry: Non-Euclidean, projective and finite geometries; regular figures.

Number Theory: asymptotic theory; finite fields; analytic number theory.

Topology: structures of continuous functions; categorical topology; fixed point theory; algebraic topology.

Applied Mathematics

Compressible fluids; shock waves; airfoil theory; diffusion and convection; magnetohydrodynamics; electromagnetic and diffraction theory; special functions; asymptotic expansions; kinetic theory of gases; upper atmosphere problems; dynamics of stellar systems; computer science.

Statistics

Probability theory; stochastic processes; multivariate analysis; operations research; distribution theory; analysis of variance; estimation theory; non-parametric methods; experimental design; sampling theory; foundations of statistical inference.

MASTER OF SCIENCE

Admission Requirements

The minimum requirements for admission to the Master's program are outlined in the general regulations section of this Calendar. Applicants with a general (pass) bachelor's degree may be admitted to a Qualifying Year program.

In addition, applicants may be required to write the Advanced Tests in Mathematics of the Graduate Record Examinations.

Program Requirements

The two program options in Mathematics are the following:

- Four full-courses and a thesis.
- Five full-courses, without a thesis.

A maximum of two of these courses may be selected from those offered at the senior undergraduate (400) level. All other courses must be at the graduate level.

At least one of the courses must be taken in a field other than the major field of the student. Ordinarily this course should be at the 500 level but in certain cases this rule may be waived by the Chairman of the Committee on Graduate Studies.

If a thesis is written, the candidate will be required to undertake an oral examination on the subject of his thesis.

DOCTOR OF PHILOSOPHY

Admission Requirements

The minimum requirements for admission to the Ph.D. program are outlined in the general regulations section of this Calendar.

Program Requirements

The course requirement is a minimum of three graduate courses and a suitable thesis. At least one of the courses must be chosen from those offered outside the candidate's major field.

Language requirements will be determined by the candidate's thesis advisory committee.

A comprehensive examination will be undertaken in the following areas:

- The candidate's general area of specialization at the Ph.D. level.
- Algebra and Analysis (if Algebra or Analysis is the area of specialization, this area of examination will be replaced by Topology).

The format of the comprehensive examination will be determined by the candidate's advisory committee, but will normally consist of written and oral sections. This examination must be passed within 18 months of admission into the Ph.D. program in the case of a full time student.

All Ph.D. candidates are also required to undertake a final oral examination on the subject of their thesis.

SELECTION OF COURSES

The following undergraduate courses may, with the approval of the Department of Mathematics, be selected by Master's candidates in partial fulfilment of their degree requirements:

Mathematics	**70.401**	Vector Calculus
	70.403	Banach Spaces
	70.407	Measure Theory
	70.415	Rings and Modules
	70.416	Group Theory
	70.417	Commutative Algebra
	70.418	Homological Algebra and Category Theory
	70.425	Introduction to General Topology
	70.426	Introduction to Algebraic Topology
	70.427	Foundations of Geometry
	70.428	Differential Geometry
	70.431	Introduction to Mathematical Logic
	70.435	Analytic Number Theory
	70.436	Algebraic Number Theory
	70.445	Analytical Dynamics
	70.446	Hydrodynamics
	70.447	Tensor Analysis and Relativity Theory
	70.448	Introduction of Electromagnetic Theory
	70.450	Parametric Estimation
	70.451	Probability Theory
	70.452	Sampling: Theory and Methods I
	70.453	Correlation and Regression Analysis
	70.456	Non-Parametric Methods I
	70.457	Testing of Hypotheses
	70.458	Stochastic Models
	70.470	Introduction to Partial Differential Equations
	70.471	Selected Topics in Partial Differential Equations
	70.472	Integral Transforms
	70.476	Special Functions
	70.485	Theory of Automata
	70.486	Numerical Analysis
	70.487	Game Theory

GRADUATE COURSES

Mathematics 70.500 Analysis

Banach spaces, Hilbert spaces, Integration theory, Distributions.
Lectures three hours a week, fall and winter terms.

Prerequisites: Mathematics 70.300, familiarity with metric spaces and general mathematical ideas at fourth year level

Reference: Lang, *Analysis II*

P. R. Beesack and M. S. Macphail

Mathematics 70.501 Abstract Measure Theory

Abstract measure and integral, L-spaces, complex measures, product measures, differentiation theory, Fourier Transforms.

Lectures three hours a week, winter term.

Prerequisite: Mathematics 70.407

P. R. Beesack

Mathematics 70.502 Distributions and Generalized Functions

Linear topological spaces, countably multinormed spaces, countable union spaces and their duals, testing function spaces, spaces of generalized functions and their structure, Schwartz distributions, calculus of distribution, convolution, analytic representation and Fourier transform of distributions.

Lectures three hours a week, fall term.

Prerequisite: Mathematics 70.403

References: Zemanian, *Distribution Theory and Transform Analysis*
           Gel'fand and Shilov, *Generalized Functions, Vols. I and II*

Lecturer to be announced

Mathematics 70.503 Banach Algebras

Commutative Banach algebras; the space of maximal ideals; representation of Banach algebras as function algebras and as operator algebras; the spectrum of an element; special types of Banach algebras e.g. regular algebras, algebras with involution; applications.

Lectures three hours a week, fall term.

Prerequisite: Permission of the Department

G. Zelmer

Mathematics 70.504 Integral Equations

A survey of the main results in the theory of non-singular linear integral equations; Volterra and Fredholm equations of first and second kind in the L_2 case, with special results for the continuous case; Hermitian kernels; eigenfunction expansions; compact operators.

Lectures three hours a week, winter term.

Prerequisites: Mathematics 70.300 and 70.403

References: Hoheisel, *Integral Equations*
           Widom, *Lectures on Integral Equations*

P. R. Beesack

Mathematics 70.505 Complex Analysis

Complex differentiation and integration, harmonic functions, maximum modulus principle, Runge's theorem, conformal mapping, entire and meromorphic functions, analytic continuation.

Lectures three hours a week, fall term.

Prerequisite: Permission of the Department

M. S. Macphail and W. Schneider

Mathematics 70.507 Structures of Continuous Functions

A study of the ring $C(X)$ of all real-valued continuous functions on a topological space X; characterization of the maximal ideals in $C(X)$ using the Stone-Cech compactification.

Lectures three hours a week, fall term.

Prerequisite: Permission of the Department

K. Hardy and L. D. Nel

Mathematics 70.509 Introduction to Hilbert Space

Geometry of Hilbert Space, spectral theory of linear operators in Hilbert Space.

Lectures three hours a week, fall term.

Prerequisites: Mathematics 70.300 and 70.403

References: Berberian, *Introduction to Hilbert Space*
Akhiezer and Glazman, *Theory of Linear Operators in Hilbert Spaces, Vol. I*

P. R. Beesack

Mathematics 70.510 General Algebra

Algebraic structures, universal algebras, lattices, direct decompositions, operator groups and rings, algebraic constructions, ordered groups and rings, normed algebras, topological groups and rings.

Lectures three hours a week, fall and winter terms.

Lectures five hours a week, spring term.

Prerequisite: Permission of the Department

M. Chacron and V. Dlab

Mathematics 70.511 Theory of Groups

Abelian groups, solvable and nilpotent groups, free groups and free products, structure of finite groups, linear groups, simple groups.

Lectures three hours a week, fall and winter terms.

Prerequisite: Permission of the Department

J. C. Poland and L. Ribes

Mathematics 70.512 Group Representations and Applications

An introduction to group representations and character theory with selected applications.

Lectures three hours a week, fall and winter terms.

Prerequisite: Permission of the Department

J. D. Dixon and B. M. Puttaswamaiah

Mathematics 70.513 Rings and Modules

Generalizations of the Wedderburn-Artin theorem and applications, homological algebra.

Lectures three hours a week, fall and winter terms.

Prerequisite: Permission of the Department

M. Chacron and V. Dlab

Mathematics 70.515 Topological Groups

General topological groups, subgroups and factor groups, local properties, Haar integral, Lie Groups.

Prerequisite: Permission of the Department

Lectures three hours a week, fall and winter terms.

M. Moore and L. Ribes

Mathematics 70.520 Topology

General topology, homotopy theory, the fundamental group, complexes, differentiable manifolds, homology theory.

Lectures three hours a week, fall and winter terms.

Prerequisites: Mathematics 70.300, 70.310

Reference: Singer and Thorpe, *Lecture Notes on Elementary Topology and Geometry*

L. Nel and H. H. Schirmer

Mathematics 70.521 Foundations of Geometry

Various axiom systems of geometry. Detailed examinations of at least one modern approach to foundations, with emphasis upon the connections with group theory.

Lectures three hours a week, fall and winter terms.

Prerequisite: Mathematics 70.427

References: Dembowski, *Finite Geometries*
         Bachman, *Aufbau der Geometrie aus dem Spiegelungsbegriff*

C. W. L. Garner

Mathematics 70.524 General Topology

Selected advanced topics, such as: generalizations of compactness, metrization, uniform spaces, dimension theory, categorical topology, multi-valued functions.

Prerequisite: Mathematics 70.425

Reference: Engelking, *Outline of General Topology*

Lectures three hours a week, fall and winter terms.

K. Hardy and L. D. Nel

Mathematics 70.526 Homology Theory

The Eilenberg-Steenrod axioms and their consequences, singular homology theory, applications to topology and algebra.

Lectures three hours a week, fall term.

Prerequisite: Mathematics 70.425

References: Hu, *Homology Theory*
         Wallace, *Algebraic Topology: Homology and Cohomology*

H. H. Schirmer and I. Pressman

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Mathematics 70.530 Methods of Number Theory
Introduction to the Hardy-Littlewood method, sieve methods of Brun and Selberg, character sums.
Lectures three hours a week, fall and winter terms.
Prerequisite: Permission of the Department
K. S. Williams

Mathematics 70.532 Algebraic Number Theory
Valuations, local fields, algebraic number fields, class number, unit theorem, extensions of number fields, ramification theory, quadratic and cyclotomic fields.
Prerequisite: Permission of the Department
Lectures three hours a week, fall and winter terms.
R. J. Semple and K. S. Williams

Mathematics 70.540 Advanced Classical Mechanics
Hamiltonian dynamics; integral invariants; non-holonomic systems; rigid body motions.
Lectures three hours a week, fall and winter terms.
Prerequisite: Mathematics 70.445
References: Whittaker, *Analytical Dynamics*
Minorsky, *Non-linear Oscillations*
R. L. Rosenberg and M. Rahman

Mathematics 70.541 Kinetic Theory of Gases and Plasmas
Irreversible processes in gases; Boltzmann and Fokker-Planck equations; theories of Bogoliubov and of Frieman and Sandri; inhomogeneous plasmas; initial and boundary value problems of gases and plasmas; the hydrodynamic stage.
Lectures three hours a week, fall and winter terms.
Prerequisite: Mathematics 70.445
References: deBoer and Uhlenbeck, *Studies in Statistical Mechanics Vol. I*
Brittin, Barut and Guenin, *Lectures in Theoretical Physics (Kinetic Theory)*
A. Smith

Mathematics 70.543 Mathematical Theory of Compressible Flow
Basic equations of inviscid, unsteady, compressible flow; solutions of three-dimensional problems by means of source, doublet and vortex distributions; compressible subsonic flow; hodograph methods and other techniques of linearization; supersonic flow; source distributions, conical flow and characteristic coordinates; hypersonic flow; small disturbance theory with applications, transonic flow.
Lectures three hours a week, fall and winter terms.
Prerequisite: Mathematics 70.446
References: Rosenhead, *Laminar Boundary Layers*
Ward, *Linearized Theory of High Speed Flow*
P. Mandl and E. J. Norminton

Mathematics 70.545 Wave Propagation and Diffraction Theory

Mathematical treatment of wave propagation; scalar and vector waves; the diffraction phenomenon; the general diffraction problem; the solvable problems; the Kirchoff-Huygens diffraction theory; applications to microwave lenses and interferometer theory.

Lectures three hours a week, fall and winter terms.

Prerequisite: Mathematics 70.448

F. H. Northover

Mathematics 70.550 Multivariate Normal Theory

Bivariate and Multivariate Normal Distributions (MND); parameters of MND; nature of MND depending on the rank of the covariance-matrix; ellipsoid of concentration; characteristic function of MND; partition vectors — distribution of partition vectors; regression function, matrix of regression coefficients; correlation, partial correlation, multiple correlation; distribution of quadratic forms; estimations of (μ, Σ); distribution of X; test of means when Σ is known or unknown; distribution of T^2; Wishart Distribution.

Lectures three hours a week, fall term.

Prerequisite: Mathematics 70.350

References: Anderson, *Introduction to Multivariate Statistical Analysis*
　　　　　　Morrison, *Multivariate Statistical Methods*
　　　　　　Kendall and Stuart, *The Advanced Theory of Statistics*

A. B. M. L. Kabir

Mathematics 70.551 Linear Programming

Linear programming problems; the simplex method; the duality problem; other constrained optimization problems; applications to transportation, inventory and allocation models; introduction to the theory of games.

Lectures three hours a week, fall term.

Prerequisites: A course in Linear Algebra and permission of the Department

References: Spivey and Thrall, *Linear Optimization*
　　　　　　Simonnard, *Linear Programming*
　　　　　　Hadley, *Linear Programming*

F. Fiala

Mathematics 70.552 Sampling Theory and Methods II

Ratio and regression estimation theory; unequal probability sampling; multi-stage sample designs; two-phase sampling; interpenetrating samples; domains of study; nonsampling errors; related topics.

Prerequisite: Mathematics 70.452 or permission of the Department

Lectures three hours a week, winter term.

References: Cochran, *Sampling Techniques*
　　　　　　Murthy, *Sampling Theory and Methods*
　　　　　　Raj, *Sampling Theory*

J. E. Graham, J. N. K. Rao

Mathematics 70.553 Analysis of Variance I

The basic mathematical theory of the analysis of variance; mathematical models; estimable functions; Gauss-Markov theorems; confidence ellipsoids; tests of hypotheses; the one-way and some higher-way layouts; analysis of covariance.

Prerequisites: Mathematics 70.450 and 70.453 or permission of the Department

Lectures three hours a week, fall term.

References: Scheffe, *The Analysis of Variance*
Kempthorne, *Design and Analysis of Experiments*

D. K. Dale and E. Saleh

Mathematics 70.554 Stationary Stochastic Processes

Introduction to stationary stochastic processes; harmonic analysis of stationary processes; estimation of the spectrum; applications to time series and communications theory.

Lectures three hours a week, fall term.

Prerequisite: Mathematics 70.451 or permission of the Department

References: Hannan, *Time Series Analysis*
Jenkins and Watts, *Spectral Analysis and its Applications*
Yaglom, *Theory of Stationary Random Functions*

D. A. Dawson

Mathematics 70.555 Design of Experiments

Interpretation of factorial experiments; confounding; fractional replication; split plot, split block, Latin square, Graeco-Latin square, lattice and incomplete block designs; response surface techniques.

Lectures three hours a week, winter term.

Prerequisite: Mathematics 70.553 or permission of the Department

References: Kempthorne, *Design and Analysis of Experiments*
Mann, *Analysis and Design of Experiments*

M. Csörgö

Mathematics 70.556 Non-Parametric Methods II

Single sample problem; the problem of replacing composite hypotheses by equivalent simple ones; two-sample problem and c-sample problem; score generating functions — properties; locally most powerful test; method of obtaining rank tests; asymptotic distribution of linear rank statistic under the null hypothesis and alternative hypothesis; power and efficiency of non-parametric tests.

Lectures three hours a week, winter term.

Prerequisite: Mathematics 70.456 or permission of the Department

M. Csörgö

Mathematics 70.557 Statistical Inference

Game and decision theory; main theorems of decision theory; optimum decision criteria; Neyman-Pearson lemma; locally most powerful test; sufficiency and completeness; unbiased and invariant estimation and test procedures.

Prerequisite: Mathematics 70.450 or permission of the Department

Lectures three hours a week, fall term.

References: Ferguson, *Mathematical Statistics — A Decision Theoretic Approach*
Lehmann, *Testing Statistical Hypotheses*
Fraser, *The Structure of Inference*

P. Tan

Mathematics 70.558 Stochastic Differential Equations

Introduction to Brownian motion and Markov diffusion processes; linear stochastic differential equations; first passage time problems; introduction to nonlinear stochastic differential equations; applications.

Lectures three hours a week, winter term.

Prerequisites: Mathematics 70.356 and 70.451 or permission of the Department

References: Gikhman and Skorokhod, *Introduction to the Theory of Random Processes*
Ito, *Lectures on Stochastic Processes*
McKean, *Stochastic Integrals*

D. A. Dawson

Mathematics 70.559 Multivariate Analysis

Multivariate methods of data analysis including discriminant analysis, component analysis, factor analysis, variance analysis, profile analysis.

Lectures three hours a week, fall term.

Prerequisite: Mathematics 70.450 or permission of the Department

References: Kendall and Stuart, *The Advanced Theory of Statistics*
Kendall, *A Course in Multivariate Analysis*
Morrison, *Multivariate Statistical Methods*
Lawley and Maxwell, *Factor Analysis as a Statistical Method*

D. K. Dale

Mathematics 70.570 Probability Theory

Axioms, motivation, probability and measure theory; random variable, distribution function, expectation and integration; independence and orthogonality; zero-one law; Borel-Cantelli lemma; Kolmorgorov's extension theorem; convergence concepts (L_p, in measure-in probability, a.e. — with probability 1), laws of large numbers, characteristic functions; central limit theorem and weak convergence; the invariance principle, Brownian motion and Brownian bridge; conditioning; Markov chains, limit theorems for

Markov chains; conditional expectation; martingales and martingale-convergence theorems.

Lectures three hours a week, fall and winter terms.

References: L. Brieman, *Probability*
K. L. Chung, *A Course in Probability Theory*
A. Renyi, *Foundations of Probability*

Prerequisites: Mathematics 70.301, 70.302, 70.407

M. Csörgö, D. Dawson, R. Fischler

Mathematics 70.580 Seminars in Mathematics

Seminars three hours a week, fall and winter terms.

Seminars five hours a week, spring term.

Members of the Department

Mathematics 70.586 Numerical Analysis

Error analysis for fixed and floating point arithmetic; systems of linear equations; eigenvalue problems; sparse matrices; interpolation and approximation including Fourier approximation; numerical solution of ordinary and partial differential equations.

Lectures three hours a week, fall term.

References: Wilkinson, *Modern Error Analysis*
Fox, *An Introduction to Numerical Linear Algebra*
Carnahan, Luther and Wilkes, *Applied Numerical Methods*

Prerequisite: Permission of the Department

Members of the Department

Mathematics 70.587 Formal Langauges and Syntax Analysis

Context-free languages; ambiguity; the parsing problem; parallel top-down and bottom-up methods; backtrack and n-backtrack methods and suitable languages; LR(k), bounded-context and precedence grammars, relation to automata.

Lectures three hours a week, winter term.

References: Hopcroft and Ullman, *Formal Languages and Their Relation to Automata*
Ginsburg, *The Mathematical Theory of Context-Free Languages*
Aho and Ullman, *The Theory of Parsing, Translating and Compiling*

Prerequisite: Permission of the Department

F. Fiala

Mathematics 70.591, 592, 593 Directed Studies

591 fall term, 592 winter term, 593 spring term.

Members of the Department

Mathematics 70.599 M.Sc. Thesis

Mathematics 70.601 Topological Vector Spaces

Linear spaces; balanced, absorbing and convex sets; seminorms; topology, nets and filters; FK spaces; duality and the Mackey-Arens theorem.

Lectures three hours a week, winter term.

Prerequisite: Mathematics 70.403

References: Robertson and Robertson, *Topological Vector Spaces*
Wilansky, *Functional Analysis*

M. S. Macphail and G. Zelmer

Mathematics 70.603 Applications of Generalized Functions

Generalized integral transforms; Laplace, Mellin, Hankel, Weierstrass, K- and Convolution transforms; solutions of partial differential equations by general integral transforms; further applications.

Lectures three hours a week, winter term.

Prerequisite: Mathematics 70.502

References: Zemanian, *Generalized Integral Transformation*
Friedman, *Generalized Functions and Partial Differential Equations*

J. N. Pandey

Mathematics 70.610 Universal Algebra

Lectures three hours a week, fall and winter terms.

Prerequisite: Permission of the Department

V. Dlab

Mathematics 70.612 Category Theory

Lectures three hours a week, fall and winter terms.

Prerequisite: Permission of the Department

I. Pressman

Mathematics 70.613 Selected Topics in Ring Theory

Lectures three hours a week, fall and winter terms.

Prerequisite: Permission of the Department

M. Chacron and V. Dlab

Mathematics 70.643 Mathematical Theory of Hypersonic Flow

Basic equations of inviscid, unsteady hypersonic flow. Small disturbance theory. Newtonian Theory. Optimum slender and non-slender body shapes. Hypersonic flow past oscillatory wedges and cones. Viscous hypersonic flow theory. Diffusion in hypersonic boundary layers. Solution of non-equilibrium flows including shock waves. Equations of rarefied gas flows.

Lectures three hours per week, fall and winter terms.

Prerequisite: Mathematics 70.543 or permission of the Department

References: Hayes and Probster, *Hypersonic Flow Theory*
Chernyi, *Introduction to Hypersonic Flow*

P. Mandl

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Mathematics 70.651 Statistical Methods in Operations Research
Dynamic programming; modelling of physical systems by Markov chains; sequential inference problems; adaptive control processes; the principle of optimality; dynamic programming under uncertainty.
Lectures three hours a week, fall term.
Prerequisites: Mathematics 70.356 and 70.551 or permission of the Department
References: Derman, *Markov Decision Processes*
Robbins, *Great Expectations: The Theory of Optimal Stopping*
Yakowitz, *Mathematics of Adaptive Control Processes*
D. A. Dawson and R. Fischler

Mathematics 70.659 Directed Studies: Topics in Probability and Statistics
Topics in probability theory, applied probability, mathematical and applied statistics.
Members of the Department

Mathematics 70.680 Seminars in Mathematics
Seminar, three hours a week, fall and winter terms
Seminar, five hours a week, spring term
Members of the Department

Mathematics 70.691, 692, 693 Directed Studies
691 fall term, 692 winter term, 693 spring term.
Members of the Department

Mathematics 70.699 Ph.D. Thesis

PHYSICS

Chairman of the Department: R. L. Clarke
Supervisor of Graduate Studies: M. K. Sundaresan

The Department of Physics offers programs of study and research leading to the M.Sc. and Ph.D. degrees.

Some of the research in the fields outlined below is being carried out in collaboration with other institutions such as the National Research Council, the University of Chicago, Argonne National Laboratory, the University of Ottawa, and others. The current research interests of the Department are the following:

Theoretical Physics

Elementary particle physics; field theory; nuclear physics; statistical mechanics (kinetic theory).

Intermediate and High Energy Physics

Muonic atoms; particle physics; new techniques (e.g. streamer chambers and wire spark chambers).

Nuclear Physics

Decay schemes following (p,γ) reactions; neutron induced reactions; capture and scattering studies of short nuclear lifetimes; isomeric states, and activation.

Applied Nuclear Physics

Radiography — the uses of external γ-rays for density measurement and for imaging of internal structures in medical diagnosis and industrial applications.

Mass Spectrometry, Geochronology and Isotope Geology; Rubidium-Strontium age determinations; isotopic abundance measurements; isotopic analysis of solids and gases.

MASTER OF SCIENCE

Admission Requirements

The normal requirement for admission is an Honours bachelor's degree with at least second class standing in Physics or a related discipline. Refer to the general regulations section of this Calendar for further details regarding admission requirements.

Program Requirements

Each candidate will choose ONE of the following optional program patterns:

- Three full-courses (of which at least two must be in Physics and two must be at the 500 level) and a thesis equivalent to two full-courses, which must be defended at an oral examination.

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- Four full-courses (of which at least two must be in Physics and three must be at the 500 level) and a thesis equivalent to one full-course, which must be defended at an oral examination.
- Five full-courses (of which at least three must be in Physics and four must be at the 500 level). One of these courses must be Physics 75.590. The candidate must also pass a final comprehensive examination (written or oral, or both).

All candidates are normally expected to select and successfully complete either Physics 75.571 or Physics 75.572.

All candidates are also expected to attend and participate in departmental seminars and colloquia.

Language requirements, prescribed to meet the needs of each student, will be determined by the candidate's supervisor.

DOCTOR OF PHILOSOPHY

Admission Requirements

Applicants for admission into the Ph.D. program must ordinarily have a Master's degree in Physics or a related discipline.

An applicant with an Honours bachelor's degree who has achieved an outstanding academic record and in addition, exhibits very strong motivation and high promise for advanced research, may be admitted to the Ph.D. program directly. Such candidates will be required to complete at least 15 full-courses, or the equivalent.

Students who have been admitted to the Master's program may be permitted to transfer into the Ph.D. program if they show outstanding academic performance and demonstrate high promise for advanced research during the first year of the Master's program.

Admission to the Ph.D. program is provisional subject to satisfactory passing of a qualifying examination, which is set soon after entry.

Program Requirements

The minimum program requirements for the Ph.D. degree in Physics are the following:

- Ten full-courses (or the equivalent) of which at least one non-thesis course must be at the 600 level in Physics.
- A thesis equivalent to approximately one half of the total course requirement. The thesis must be defended at an oral examination.
- A comprehensive examination (written and oral) which will normally be completed prior to starting the Ph.D. thesis research.

- Language requirements, as determined by the candidate's supervisor.
- Attendance and participation in departmental seminars and colloquia.

Students who have been admitted to the Ph.D. program on the basis of a 15-course requirement, which will normally require three years of full-time study, must complete the following:

- Fifteen full-courses, or the equivalent.
- A comprehensive examination.
- A research thesis equivalent to a maximum of eight of the 15-course requirement.
- The language requirement outlined above.

SELECTION OF COURSES

The following senior undergraduate courses are approved for selection by graduate students in the Department:

Physics 75.477 Introduction to Quantum Mechanics I

      75.478 Introduction to Quantum Mechanics II—Applications

GRADUATE COURSES

Graduate students may register in the following courses, subject to the approval of the Department of Physics:

Physics 75.511 Classical Mechanics and Theory of Fields
Hamilton's principle. Conservation laws. Canonical transformations. Hamilton-Jacobi theory. Lagrangian formulation of classical field theory.
Lectures three hours a week, fall term.
Text: Goldstein, *Classical Mechanics*
J. E. Hardy

Physics 75.522 Molecular Spectroscopy
Also offered as Chemistry 65.509.
Spectra of simple molecules. Brief survey of atomic spectroscopy. Rotations and vibrations of diatomic and polyatomic molecules and the methods of obtaining information about the geometrical structure of the molecule and the forces acting between the constituent particles from the observed rotation and vibration spectra. Electronic structure of molecules as derived from a study of electronic spectra based mainly on molecular orbital theory. The description will be from the point of view of the experimentalist rather than the theorist.
Lectures three hours a week, winter term, evening division.
Prerequisites: Physics 75.477 or Chemistry 65.310
G. Herzberg and J. A. Koningstein (Assistant)
Next offered 1974-75

Physics 75.532 Classical Electrodynamics

Covariant formulation of electrodynamics. Lenard-Wiechert potentials. Radiation reaction. Plasma physics. Dispersion relations.

Lectures three hours a week, winter term.

Text: Jackson, *Classical Electrodynamics*

K. W. Edwards

Physics 75.541 Fundamental Principles of Statistical Mechanics

Postulates of classical statistical mechanics; microcanonical, canonical and Grand canonical ensembles; fluctuations. Postulates of quantum statistical mechanics; density matrix; ensembles in quantum statistical mechanics. Darwin Fowler method. Equations of state for ideal classical, Fermi and Bose gases. Imperfect gases. Phase transitions; theory of Lee and Yang; Ising model; Onsager solution.

Lectures three hours a week, fall term.

Prerequisites: Physics 75.477, 75.478, 75.511

Text: Huang, *Statistical Mechanics*

M. K. Sundaresan

Physics 75.542 Non-Equilibrium Statistical Mechanics

Boltzmann Equation: Chapman-Enskog theory. Kinetic equations for gases and plasmas based on Bogoliubov's theory. The theory of Frieman and Sandri, Divergence difficulties associated with density expansions. Formulation of the equations for the hydrodynamical stage.

Lectures three hours a week, winter term.

Prerequisites: Physics 75.511, 75.532

Reference Texts: Huang, *Statistical Mechanics*
Wu, *Kinetic Equations for Gases and Plasmas*

M. K. Sundaresan

Not offered 1973-74

Physics 75.561 Experimental Techniques of Nuclear and Elementary Particle Physics

The interaction of radiation and high energy particles with matter. Experimental methods of detection and acceleration of particles. Use of relativistic kinematics. Counting statistics. Beam optics.

Lectures three hours a week, fall term.

Prerequisites: Physics 75.437, 75.468, 75.477, 75.478

Reference Texts: Rossi, *High Energy Particles*
Yuan and Wu, *Methods of Experimental Physics,* Vol. 5

E. P. Hincks

Physics 75.562 Physics of Elementary Particles

Description of properties of elementary particles; pions, kaons and baryons. Conservation laws, invariance principles and quantum numbers. Resonances

observed in final state interactions. Three body phase space; Dalitz plot. SU_3 symmetry scheme for classifying elementary particles, mass formulae and electromagnetic mass differences. Weak interactions; decay of neutral kaons; CP violation in neutral K decays.

Lectures three hours a week, winter term.

Prerequisite: Physics 75.477

L. Copley

Physics 75.564 Intermediate Nuclear Physics

Properties of the deuteron and the neutron-proton force. Nucleon-nucleon forces, isospin and charge independence.

Nuclear models: Single particle shell model, shell model with interactions, pairing, quasi-particles, collective models, deformed shell model.

Scattering theory: Effective range theory, partial wave analysis, phase shifts.

Interpretation of n-p and p-p scattering experiments. Interaction of nucleons with electrons.

Interaction of nuclei with radiation: Multipole fields, transition rates, selection rules, internal conversion.

Lectures three hours a week, winter term.

Prerequisite: Physics 75.561

Text: De Benedetti, *Nuclear Interactions*

D. Kessler

Physics 75.571 Intermediate Quantum Mechanics with Applications

Review of the basic postulates of quantum mechanics; applications of quantum mechanics to nonrelativistic system — atoms, molecules and nuclei. Scattering theory; applications. Dirac's one particle theory.

Lectures three hours a week, fall term.

Prerequisites: Physics 75.477, 75.478

Texts: Bethe and Jackiw, *Intermediate Quantum Mechanics*
        Bjorken and Drell, *Relativistic Quantum Mechanics*

W. J. Romo

Physics 75.572 Relativistic Quantum Mechanics

Relativistic wave equations. Expansion of S matrix in Feynman perturbation series. Feynman rules. An introduction to Quantum Electrodynamics without second quantization.

Lectures three hours a week, winter term.

Prerequisite: Physics 75.571

Reference Texts: Bjorken and Drell, *Relativistic Quantum Mechanics,*
                  Vol. I
                  Sakurai, *Advanced Quantum Mechanics*

L. Resnick

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Physics 75.581 Methods of Theoretical Physics I

This course and Physics 75.582 are designed for students who wish to acquire a wide background of mathematical techniques.

Lectures three hours a week, fall term.

Prerequisite: Permission of the Department

Reference Texts: Wittaker and Watson, *A Course of Modern Analysis*
                Bell, *Special Functions for Scientists and Engineers*

D. J. Brown

Physics 75.582 Methods of Theoretical Physics II

This is a continuation of Physics 75.581. Topics include group theory, discussion of SU2, SU3 and other symmetry groups. Lorentz group. Integral equations and eigenvalue problems.

Lectures three hours a week, winter term.

Prerequisite: Permission of the Department

J. E. Hardy

Physics 75.590 Selected Topics in Physics (M.Sc. level)

A student may, with the permission of the Department, take more than one selected topic; in which case each full course in Physics 75.590 will be counted for credit. Not more than one selected topic may be counted for credit in any one academic year.

Tutorials, fall and winter terms.

Members of the Department

Physics 75.599 M.Sc. Thesis

Physics 75.660 Advanced Nuclear Physics

Review of nuclear forces. Meson theory of nuclear forces. Nuclear ground states: Hartree-Fock and Bruckner-Goldstone theories of nuclear matter.

In-depth treatment of shell model and collective model. Theory of nuclear interactions.

Seminars three hours a week, fall and winter terms.

Prerequisites: Physics 75.561, 75.564 and 75.571

W. J. Romo

Not offered 1973-74

Physics 75.663 Topics in Elementary Particle Physics Phenomenology

This course is intended to develop familiarity with a wide variety of phenomenological concepts in dealing with elementary particle interactions, with special emphasis on Regge poles, cuts, absorption models, duality; inclusive reactions, deep inelastic scattering; CP violation in weak interactions, etc.

Lectures three hours a week, fall term.

Prerequisites: Physics 75.562, 75.571, 75.572

Lecturer to be announced

Physics 75.671 Quantum Electrodynamics

Relativistic quantum field theory; second quantization of Bose and Fermi fields. Reduction and LSZ formalism. Perturbation expansion and proof of renormalizability of quantum electrodynamics. Calculations of Radiative corrections and applications.

Lectures three hours a week, fall term.

Prerequisites: Physics 75.511, 75.532, 75.571, 75.572

Text: Bjorken and Drell, *Relativistic Quantum Fields*

L. Resnick

Physics 75.672 Selected Topics in Quantum Field Theory

Topics of current interest, such as unified field theories of electromagnetic and weak interactions, renormalization problems, etc. will be treated. Scale invariance, light cone singularities of current commutators; current algebras, sum rules.

Lectures three hours a week, winter term.

Prerequisite: Physics 75.671

Lecturer to be announced

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CHANCELLOR
To be announced

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Michael K. Oliver, B.A., M.A., PH.D., LL.D., D.C.L., F.R.A.I.C.

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The President and Vice-Chancellor

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D. M. Coolican, B.ENG., B.SC.
F. E. Gibson, B.COM.
J. Lorne Gray, D.SC., LL.D.
K. Kaplansky, ESQ.
Bertram Loeb, M.A.
T. R. Montgomery, ESQ.
R. J. Neill, ESQ.
Sylvia Ostry, B.A., M.A., PH.D.
C. G. Watt, B.A.

Retire 1974
J. C. Clarke, B.A., LL.B.
G. Collins, B.SC.
Jane H. Dunn
C. Edwards, ESQ.
G. H. MacCarthy, B.A.
H. H. J. Nesbitt, B.A., M.A., PH.D., D.SC., F.L.S., F.R.E.S., F.Z.S.
K. Z. Paltiel, B.A., M.A., PH.D.
L. Rasminsky, C.C., C.B.E., B.A., LL.D., D.H.L., D.C.L.
D. A. Ross, B.COM., F.C.A.
F. K. Venables, B.A.

Retire 1975
J. M. Holmes, B.SC., M.A., PH.D., F.C.I.C.
C. Kelley, B.A.
B. Laskin, B.A., M.A., LL.D., LL.M.

Grace E. Maynard, M.A., PH.D.
H. Soloway, B.A., Q.C.
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H. L. Willis, B.A., M.ED., ED.D., F.C.C.T.

Secretary

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President M. K. Oliver, B.A., M.A., PH.D., LL.D., D.C.L., F.R.A.I.C.
Dean J. Ruptash, B.SC., M.A.SC., PH.D.
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Dean R. A. Wendt, M.A.
Director, School of Social Work

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Special Appointments

Mr. G. H. Briggs, B.A., M.A., DIP.LIB., DIP.ARCH.
Mr. Bruce Cameron
Professor J. M. Holmes, B.SC., M.A., PH.D., F.C.I.C.
Mr. J. I. Jackson, D.F.C., B.A., M.F.A.
Mr. Dan Killoran
Mr. A. B. Larose, B.COM., C.A.
Professor G. R. Love, M.A., PH.D.
Professor M. S. Macphail, B.A., M.A., D.PHIL., F.R.S.C.
Dean V. F. Valentine, M.A.

Elected Members

Professor J. W. ApSimon, B.SC., PH.D.
Assistant Professor D. K. Bernhardt, B.A., M.A.
Associate Professor R. C. Biggs, B.SC., M.S., PH.D.
Professor J. Churchill, B.MUS., F.R.C.O., G.R.S.M., L.R.A.M., A.R.C.M.
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Assistant Professor R. G. Laird, B.A., M.A.
Professor N. H. Lithwick, B.A., PH.D.
Professor P. V. Lyon, B.A., M.A., D.PHIL.
Associate Professor M. Marshall, B.A., M.A., PH.D.
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Professor T. J. Ryan, M.A., PH.D.
Associate Professor T. J. Scanlon, B.J., D.P.A., M.A.
Professor M. J. Sydenham, B.A., PH.D., F.R.S.A., F.R.HIST.S.
Associate Professor D. R. F. Taylor, M.A., P.G.C.E., PH.D.
Associate Professor J. M. Thompson, M.A.
Professor W. M. Tupper, M.SC., PH.D.
Assistant Professor J. M. Yalden, B.A., M.A.
Assistant Professor G. Zelmer, B.SC., PH.D.

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A. Trevor Tolley, B.A. Oxford

Dean, Division II of the Faculty of Arts
Russell Allan Wendt, M.A. Alberta

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Derek William Sida, M.SC., PH.D. London

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    John Ruptash, B.SC. Alberta, M.A.SC., PH.D. Toronto, F.C.A.S.I.

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    H. H. J. Nesbitt, B.A. Queen's, M.A., PH.D. Toronto, D.SC. Leiden,
    F.L.S., F.R.E.S., F.Z.S.

Director of the School of Architecture
    Douglas Shadbolt, B.ARCH. Oregon, F.R.A.I.C.

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    Davidson Dunton, LL.D. Saskatchewan, Queen's, British Columbia, *
    McGill, Toronto, Carleton, D.SC. Laval

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    G. B. Doern, B.COM. Manitoba, M.A. Carleton, PH.D. Queen's

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    G. H. Briggs, B.A., M.A. Cantab., DIP. LIB., DIP. ARCH. London

Registrar
    J. I. Jackson, D.F.C., B.A. British Columbia, M.F.A. Iowa

Director of Administrative Services
    D. N. Brombal, B.A.

Director of the Computing and Data Processing Centre
    W. Dietiker, B.SC. British Columbia, PH.D. Victoria University of
    Manchester

Director of Finance
    J. K. Kettles, B.COM. Carleton, C.A.

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Dean of Student Services
    Victor F. Valentine, M.A. Toronto

Director of Counselling and Health Services
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Acting Provost of Residences
  Richard Brown, B.A. Carleton

FACULTY

The following list comprises those members of the Faculty of Carleton University who offered graduate courses or supervised thesis research work during 1972-73 and those who are expected by their department to do so in 1973-74. Those whose names are accompanied by an asterisk are part-time, special or adjunct appointments.

Department of Biology
  C. A. Barlow, M.A. Toronto, PH.D. Leiden.
  Isabel Law Bayly, B.SC. Carleton, M.A. Toronto.
  Thomas W. Betz, M.A. Missouri, PH.D. Illinois.
  *E. L. Bousfield, M.A. Toronto, PH.D. Harvard.
  G. R. Carmody, A.B., PH.D. Columbia.
  *A. H. Clarke, B.SC. Boston, M.SC. Cornell, PH.D. Harvard.
  M. B. Fenton, B.SC. Queen's, M.SC., PH.D. Toronto.
  David R. Gardner, B.SC., PH.D. Southampton.
  *G. Haggis, B.SC. Cantab., PH.D. London.
  *D. G. Harcourt, B.S.A. Toronto, PH.D. Cornell.
  *J. S. Hart, B.A., M.A., PH.D. Toronto.
  H. F. Howden, M.S. Maryland, PH.D. North Carolina.
  W. I. Illman, M.SC., PH.D. Western Ontario.
  V. N. Iyer, M.SC., PH.D. Bombay.
  S. J. Jacobson, B.C.E. Cornell, M.SC., PH.D. Minnesota.
  K. W. Joy, B.SC., PH.D. Bristol.
  John D. H. Lambert, B.SC. Vermont, M.SC. McGill.
  Peter E. Lee, B.SC. Manitoba, M.SC., PH.D. Wisconsin.
  *E. E. Lindquist, B.SC., M.SC., PH.D. California.
  Margaret E. McCully, M.S.A. Toronto, PH.D. Harvard.
  H. Gray Merriam, B.SC. Guelph, PH.D. Cornell.
  J. M. Neelin, B.A., PH.D. Toronto.
  Herbert H. J. Nesbitt, B.A. Queen's, M.A., PH.D. Toronto, D.SC.
      Leiden, F.L.S., F.R.E.S., F.Z.S.
  *D. R. Oliver, B.A., M.A. Saskatchewan, PH.D. McGill.
  *H. Robertson, B.SC., PH.D. Edinburgh, F.R.I.C., F.R.S. Edinburgh.
  George Setterfield, B.A. British Columbia, PH.D. Wisconsin.
  J. Sinclair, B.SC., DIP. IN BIOPHYSICS Edinburgh, PH.D. East Anglia.
  D. A. Smith, M.A., PH.D. Toronto.
  John A. Webb, B.SC., PH.D. London.
  Frank Wightman, B.SC., PH.D. Leeds.
  *D. M. Wood, M.A. Toronto, PH.D. Leeds.
  H. Yamazaki, M.S. Hokkaido, PH.D. Wisconsin.

Institute of Canadian Studies

A. D. Dunton, LL.D. Saskatchewan, Queen's, British Columbia, McGill, Toronto, Carleton, D.SC. Laval

N. H. Lithwick, B.A. Western Ontario, M.A., PH.D. Harvard.

John Porter, B.SC., D.SC. London.

*J. W. Pickersgill, B.A., M.A. Manitoba, B.LITT. Oxford.

Department of Chemistry

C. H. Amberg, M.A. Queen's, PH.D. Toronto, F.C.I.C.

J. W. ApSimon, B.SC., PH.D. Liverpool.

R. G. Barradas, B.SC. Liverpool, PH.D. Ottawa, F.R.I.C., F.C.I.C.

G. W. Buchanan, B.SC., PH.D. Western Ontario.

C. L. Chakrabarti, B.SC. Calcutta, M.SC. Birmingham, PH.D. Belfast, F.R.I.C., F.C.I.C.

J. M. Holmes, B.SC. New Brunswick, M.A. Western Ontario, PH.D. McGill, F.C.I.C.

J. A. Koningstein, D.SC. Amsterdam.

P. Kruus, B.SC. Toronto, LIC.TECH. Denmark, PH.D. Toronto.

C. H. Langford, A.B. Harvard, PH.D. Northwestern.

P. M. Laughton, B.A. Toronto, M.SC. Dalhousie, PH.D. Wisconsin, F.C.I.C.

M. Parris, M.A., D.PHIL. Oxford.

R. A. Shigeishi, B.SC. Toronto, PH.D. Queen's.

C. S. Tsai, B.SC. Taiwan, M.SC., PH.D. Purdue.

D. C. Wigfield, B.SC. Birmingham, PH.D. Toronto.

R. H. Wightman, B.SC., PH.D. New Brunswick.

D. R. Wiles, B.SC. Mount Allison, M.SC. McMaster, PH.D. M.I.T., F.C.I.C.

J. S. Wright, B.SC. Stanford, PH.D. Berkeley.

Department of Classics

D. G. Beer, B.A. Bristol, M.A. McMaster.

R. C. Blockley, B.A. Leicester, M.A. McMaster, PH.D. Nottingham.

A. S. Fotiou, B.A. Salonika, M.A., PH.D. Cincinnati.

A. T. Hodge, M.A., PH.D. Cambridge.

T. R. Robinson, M.A., PH.D. Belfast.

F. Ellenor M. Swallow, M.A. Alberta, PH.D. Cornell.

M. E. Walsh, B.A. Rhodes and Capetown, PH.D. London.

Department of Comparative Literature

Hans-George Ruprecht, DR.PHIL. Saarbrücken (Full appointment).

Eva Kushner, M.A., PH.D. McGill (Cross appointment).

Wladimir Krysinski, MAG. Lodz, D. ES L. Strasbourg (Cross appointment).

Adam Tarn, DR. D'UNIV. Lille (Cross appointment).

Department of Economics

A. L. K. Acheson, B.A., PH.D. Toronto.

Michael D. Bordo, B.A. McGill, M.SC. London.

Thomas Newton Brewis, M.COM., PH.D. Durham.
Richard Lee Carson, M.A. Minnesota, PH.D. Indiana.
E. U. Choudhri, M.A. Punjab.
John C. Danielsen, B.A. San Diego, PH.D. California.
H. Edward English, B.A. British Columbia, PH.D. California.
W. Irwin Gillespie, B.A. Western Ontario, PH.D. Johns Hopkins.
Keith A. J. Hay, B.SC. Southampton, M.SC. Toronto.
Walter P. Hettich, B.A. California, M.A., PH.D. Yale.
Caswell L. Johnson, B.A. McGill, M.A., PH.D. Columbia.
N. H. Lithwick, B.A. Western Ontario, PH.D. Harvard.
A. J. Little, B.A. Nottingham, M.COM., PH.D. Melbourne.
I. A. Litvak, B.COM. McGill, M.S., PH.D. Columbia.
Kanta Marwah, M.A. Punjab, PH.D. Pennsylvania.
C. J. Maule, B.A. British Columbia, M.A. Queen's, PH.D. London.
Sydney J. May, M.COM. McGill.
R. T. McKinnell, B.A., M.A. Natal, M.SC. Cambridge.
John C. McManus, B.A., M.A. Western Ontario, PH.D. Toronto.
Carl H. McMillan, M.A. Yale.
Gilles Paquet, M.A. Laval.
Soo Bin Park, M.ECO. Seoul, M.A., PH.D. Indiana.
Georg Rich, LIC. OEC. PUBL. Zurich, PH.D. Brown.
Archibald R. M. Ritter, B.A. Queen's, M.A. Western Ontario.
Thomas K. Rymes, B.A. Manitoba, M.A., PH.D. McGill.
Richard F. Sullivan, B.A. Boston, M.A. California.
Richard D. Vanderberg, B.A. Wyoming, M.SC. Western.
Edwin G. West, B.A. Exeter, M.SC., PH.D. London.

Faculty of Engineering

A. N. Abdelhamid, M.SC. Cairo, PH.D. Syracuse.
W. R. Bezanson, B.SC. Dalhousie, M.ENG. Nova Scotia Technical
  College.
Malcolm J. Bibby, M.SC., PH.D. Alberta.
Gordon W. Bigg, B.SC. Alberta, M.SC., PH.D. Illinois.
R. C. Biggs, B.SC. Queen's, M.S. Stanford, PH.D. McGill.
F. W. Black, B.SC. (M.E.) Manitoba, M.A.SC., PH.D. Toronto.
A. R. Boothroyd, B.SC.ENG., PH.D. London, F.I.E.E.E.
B. A. Bowen, B.SC., M.SC. Queen's, PH.D. Syracuse.
*R. R. Bowen, M.SC. Queen's, PH.D. Carleton.
William H. Bowes, M.E. Nova Scotia Tech., M.SC. Michigan.
John P. Braaksma, B.A.SC., M.A.SC. Waterloo.
R. J. A. Buhr, B.SC. Queen's, M.SC. Saskatchewan, PH.D. Cam-
  bridge.
James K. Cavers, B.A.SC., PH.D. British Columbia.
*E. P. Cockshutt, B.A.SC. Toronto, S.M., MECH.ENG., SC.D. M.I.T.
David C. Coll, M.ENG. McGill, PH.D. Carleton.
D. R. Conn, M.SC., PH.D. Queen's.
Miles A. Copeland, B.SC. Manitoba, M.A.SC., PH.D. Toronto.
George D. Cormack, M.SC., PH.D. British Columbia.

*John DaSilva, B.A.SC., M.A.SC. Montreal.

*J. de Mercado, M.SC., PH.D. Ottawa.

*Donald W. Dunn, B.A. Queen's, PH.D. M.I.T.

E. Bryan Fletcher, B.A. Royal Military College, B.A.SC., PH.D. Waterloo.

Donald A. George, B.ENG. McGill, M.S. Stanford, SC.D. M.I.T.

John A. Goldak, M.SC., PH.D. Alberta.

M. A. Gullen, B.SC. Edinburgh, M.S. Purdue.

S. G. Haider, M.SC., B.ARCH., PH.D. Illinois.

G. Kardos, M.ENG., PH.D. McGill.

D. A. Kasianchuk, B.SC.(C.E.) Manitoba, M.A.SC. Toronto, PH.D. California.

D. J. L. Kennedy, B.A. SC. Toronto, M.S., PH.D. Illinois.

Ata M. Khan, B.ENG., M.ENG. American University of Beirut, PH.D. Waterloo.

R. J. Kind, B.SC. Loyola, B.ENG. McGill, PH.D. Cambridge.

James Kirkhope, B.SC. Strathclyde, GRAD. DIP. ENG. McGill.

*G. Klein, B.A. SC. Toronto.

J. P. Knight, B.SC. Queen's, M.A.SC., PH.D. Toronto.

J. Lukasiewicz, D.I.C. Imperial, DIPL. ENG. Polish Technical, D.SC. (ENG.) London.

Vassilios Makios, M.ENG., PH.D. Munich.

R. F. Manuel, B.SC. Alberta, M.SC. Queen's, PH.D. Alberta.

Douglas A. J. Millar, B.A.SC. British Columbia, M.E., SC.D. M.I.T.

L. R. Morris, B.A.SC. Toronto, D.I.C. Imperial, PH.D. London.

B. Pagurek, M.A.SC., PH.D. Toronto.

W. J. Rainbird, B.ENG. Canterbury, DIP. Cranfield College of Aeronautics, F.C.A.S.I.

J. S. Riordon, M.ENG. McGill, D.IC. Imperial, PH.D. London.

J. T. Rogers, B.ENG., M.ENG., PH.D. McGill.

John Ruptash, B.SC. Alberta, M.A.SC., PH.D. Toronto, F.C.A.S.I.

H. I. H. Saravanamuttoo, B.SC. Glasgow, PH.D. Bristol.

*D. E. Sullivan, M.A., Calgary.

G. T. Suter, B.ENG.SC. Western Ontario, M.A.SC., PH.D. Toronto.

*Ronald Taborek, B.A.SC. Toronto, M.SC. Imperial, DIP. London.

*R. J. Templin, B.A.SC. Toronto.

R. E. Thomas, B.SC. New Brunswick, D.I.C. Imperial College, PH.D. London.

C. R. Thompson, B.SC. Alberta, M.ENG. Carleton.

P. D. van der Puij, B.SC.(ENG.) Kumasi, D.I.C. Imperial, PH.D. London.

*A. L. Van Koughnett, B.ENG.SC. Western Ontario, M.A.SC., PH.D. Toronto.

Jo-Yung Wong, B.SC. Tsing Hua, PH.D. Newcastle Upon Tyne.

C. M. Woodside, B.A.SC. Toronto, PH.D. Cambridge.

*David A. Wright, B.SC. Alberta, S.M., E.E. M.I.T.

Whitman E. Wright, B.A.SC. Toronto, M.SC., PH.D. Illinois.

Department of English

Alexander Munro Beattie, B.A. Toronto, M.A., PH.D. Columbia.
V. K. Chari, M.A., PH.D. Benares.
L. A. Cormican, O.M.I., B.A. Dublin, M.A. Cantab., S.T.L. Rome.
T. H. Coulson, M.A. Oxon.
Patrick Cruttwell, M.A. Cantab.
James Downey, B.ED., M.A. Memorial, PH.D. London.
Mary Jane Edwards, B.A. Toronto, M.A. Queen's, PH.D. Toronto.
Michael M. Gnarowski, B.A. McGill, M.A. Montreal, PH.D. Ottawa.
Maureen Gunn, M.A., B.LITT. Oxon, L.PH. Montreal.
Charles Haines, M.A. Dublin.
John J. Healy, M.A. Leeds, PH.D. Texas.
T. J. Henighan, M.A. St. John's, N.Y., M.LITT. Durham.
Robert L. Hogg, M.A. British Columbia.
George B. Johnston, M.A. Toronto, LL.D. Queen's.
Benjamin W. Jones, B.A. Grinnell, A.M. Columbia, PH.D. Iowa.
Marston LaFrance, B.A. Harpur, M.A. Cornell, PH.D. Wisconsin.
Robert G. Laird, B.A. British Columbia, M.A. Yale.
Robin H. MacDonald, B.A. New York, PH.D. Edinburgh.
A. A. MacKinnon, O.M.I., B.A. St. Francis Xavier, M.A. Windsor.
Robin D. Mathews, B.A. British Columbia, M.A. Ohio.
George McKnight, B.A. British Columbia, M.A. McMaster.
Alan D. McLay, B.A. McMaster, M.A. New Brunswick,
    PH.D. Wisconsin.
Thomas J. Middlebro', M.A. Toronto.
James R. Morrison, B.A. Manitoba, M.A. Toronto.
James Noonan, O.M.I., B.A. St. Patrick's, B.A. Cambridge.
Kathleen O'Donnell, B.A. McGill, M.A. Western Ontario,
    PH.D. Montreal.
Enoch D. Padolsky, B.A. Manitoba, M.A. California.
Ian W. V. Pringle, M.A. Auckland.
R. Barry Rutland, B.A. Toronto, M.A., PH.D. London.
Mariana Ryan, M.A. Toronto, D.U. Paris.
James Steele, M.A. Toronto, PH.D. London.
Adam Tarn, D.U. Lille.
Alistair Tilson, M.A. St. Andrews, B.LITT. Oxford.
A. Trevor Tolley, B.A. Oxford.
Faith Westburg, B.A. Southmore, M.A. California.
James M. Wilcox, B.S., M.A. Michigan, PH.D. Wayne State.
Gordon James Wood, M.A. Toronto.
Douglas J. Wurtele, B.A. London, M.A., PH.D. McGill.
Lorna D. Young, B.A. Carleton, M.A. Rochester, PH.D. Dublin.

Department of French

A. Bergens, B.S., M.A., PH.D. Columbia.
P. Clive, B.A., PH.D. London.
F. Cousin, LIC. D'ANGLAIS, D.E.S. Paris, DR. D'UNIV. Nanterre.
A. Elbaz, L. ES L. Bordeaux, C.A.P.E.S., DR. D'UNIV. Sorbonne.

C. Fleischauer, A.M., PH.D. Harvard.

R. Galliani, LAUREA Pisa, DR. D'UNIV. Bordeaux.

M. Gaulin, B.A. Ottawa, M.A. Montreal.

M. Gobeil, B.A. Ottawa, M.A. McGill.

C. Hérisson, L. ES L. Toulouse, M.A. Lafayette, D. EN DROIT
  Toulouse, F.R.S.C.

W. Kay, M.A. Toronto, PH.D. U.C.L.A.

E. Kaye, M.A. Christchurch, L. ES L. Dijon, DR. D'UNIV. Besançon.

E. Kushner, M.A., PH.D. McGill.

W. Krysinski, MAG. Lodz, D. ES L. Strasbourg.

P. Laurette, L. ES L. Lille, D.E.S., D.PHIL. Saarbrücken,
  DR. D'UNIV. Strasbourg.

J. Miquet, M.A. London, L. ES L. Paris, DR. D'UNIV. Poitiers.

A. Roth, L. ES L., D.E.S. Strasbourg, C.A.P.E.S. Lille, PH.D.
  Western Ontario.

J. Ryngaert, L. ES L., D.E.S. Lille.

S. Sarkany, L. ES L. Budapest, DIP.SC.POL. Paris, DR. D'UNIV.
  Strasbourg.

A. Tarn, DR. D'UNIV. Lille.

J. S. Tassie, B.A. McMaster, M.A., PH.D. Toronto.

P. Van Rutten, DR. EN PHIL. Ottawa.

E. Zimmerman, B.A. Barnard, M.A., PH.D. Wisconsin.

Department of Geography

D. Bennett, B.A. Liverpool.

J. Clarke, B.A. Belfast, M.A. Manitoba, PH.D. Western Ontario.

D. P. Fitzgerald, B.A. Bristol, M.A. Nebraska, Minnesota,
  PH.D. Minnesota, F.R.G.S., F.R.S. (T.).

J. P. Johnson, A.B. Dartmouth College, A.M. Clark, PH.D. McGill.

D. B. Knight, B.A. Macalester, M.A. E. Michigan.

G. C. Merrill, M.A. McGill, PH.D. California.

R. O. Ramseier, B.SC. State Eng. Coll. Burkdoor, M.SC. Dartmouth.

M. W. Smith, B.SC. Liverpool, M.A. Georgia.

*A. D. Stanley, B.SC., M.SC. London, PH.D. British Columbia.

D. R. F. Taylor, M.A. Edinburgh, P.G.C.E. London, PH.D.
  Edinburgh.

*G. C. Topp, B.S.A., M.S., PH.D. Wisconsin.

J. K. Torrance, B.S.A. Guelph, M.S., PH.D. Cornell.

J. E. Tunbridge, B.A., M.A. Cantab., PH.D. Bristol.

P. E. Uren, M.A. McGill, PH.D. Ottawa.

A. I. Wallace, B.A., M.A., D.PHIL. Oxon.

T. P. Wilkinson, B.SC., PH.D. Durham.

P. J. Williams, B.A., M.A. Cambridge, FIL. LIC., FIL. DR. Stockholm.

Department of Geology

Keith Bell, B.SC. Leeds, D.PHIL. Oxford.

*R. L. Borden, M.SC. Alberta, M.B.A. Western Ontario.

*R. W. Boyle, M.SC., PH.D. Toronto, F.R.S.C.

R. L. Brown, B.SC. McGill, PH.D. Edinburgh.

240

G. Y. Chao, M.SC., PH.D. Chicago.
J. A. Donaldson, B.SC. Queen's, PH.D. Johns Hopkins.
Patrick Arthur Hill, B.SC. London, PH.D. Columbia.
K. Hooper, M.SC., PH.D. London.
*E. Irving, M.A., M.SC., SC.D. Cambridge.
John M. Moore, B.SC. Manitoba, PH.D. M.I.T.
F. K. North, M.A., D.PHIL. Oxford.
Giorgio Ranalli, DOTT. SC. GEOL. Rome, M.S., PH.D. Illinois.
G. B. Skippen, M.SC. McMaster, PH.D. Johns Hopkins.
*Alan D. Stanley, B.SC., M.SC. London, PH.D. British Columbia.
William M. Tupper, M.SC. New Brunswick, PH.D. M.I.T.
David H. Watkinson, B.SC., M.SC. McMaster, PH.D.
    Pennsylvania State.
Raymond W. Yole, B.SC. New Brunswick, M.A. Johns Hopkins,
    PH.D. British Columbia.

Department of German

Joseph B. Dallett, A.B. Harvard, A.M. Pennsylvania, PH.D. Harvard.
Jutta Goheen, DR.PHIL. Potsdam.
Robert Gould, M.A. Oxford, PH.D. Princeton.
Katharina Mommsen, DR.PHIL. Tübingen, DR.HABIL. Berlin.
B. F. Mogridge, M.A., PH.D. Cambridge, DIP. DU
    COLLEGE D'EUROPE, Bruges.
E. M. Oppenheimer, B.A. Toronto, M.A. Columbia, PH.D. Harvard.

Department of History

R. Carter Elwood, B.A. Dartmouth, M.A., PH.D. Columbia.
D. M. L. Farr, M.A. Toronto, D.PHIL. Oxford.
M. G. Fry, B.SC., PH.D. London.
Peter John King, M.A. Cambridge, A.M., PH.D. Illinois.
S. R. Mealing, B.A. Alberta, M.A., B.LITT. Oxford.
H. B. Neatby, M.A. Oxford, PH.D. Toronto.
F. Ouellet, LICENCE ES LETTRES, DOCTORATE ES LETTRES, Laval.
M. J. Sydenham, PH.D. London.
*S. F. Wise, M.A. Queen's.

School of International Affairs

Gerard Curzon, B.SC. London, PH.D. Geneva.
H. Edward English, B.A. British Columbia, PH.D. California.
D. M. L. Farr, M.A. Toronto, D.PHIL. Oxford.
Dennis Forcese, B.S., M.A. Manitoba, PH.D. Washington at St. Louis.
Kurt Gasteyger.
I. A. Litvak, B.COM. McGill, M.S., PH.D. Columbia.
Peyton V. Lyon, B.A. Manitoba, M.A., D.PHIL. Oxford.
C. J. Maule, B.A. British Columbia, M.A. Queen's, PH.D.
    London School of Economics.
Bruce A. McFarlane, B.A., M.A. McGill, PH.D. London.
*Lynn K. Mytelka, M.A., PH.D. Johns Hopkins.
John R. Nellis, M.A., PH.D. Syracuse.

A. F. W. Plumptre, B.A. Toronto, B.A. Cambridge, M.A. King's College.

Ian Pool, B.A., M.A. New Zealand, PH.D. Australian National.

A. R. M. Ritter, B.A. Queen's, M.A. Western Ontario.

D. R. F. Taylor, M.A. Edinburgh, P.G.C.E. London, PH.D. Edinburgh.

E. L. Tepper, B.A. Michigan, M.A. American University, PH.D. Duke.

B. B. Thapa, B.A. Calcutta, M.A., PH.D. Claremont.

Harald von Riekhoff, B.A. Western Ontario, M.A., PH.D. Yale.

Department of Law

Donald Fraser, LL.B. Queen's.

J. George Neuspiel, LL.B. Queen's, London.

Department of Mathematics

Paul R. Beesack, B.A. McMaster, A.M., PH.D. Washington.

Maurice Chacron, PH.D. Paris.

Miklos Csörgö, B.A. Budapest, M.A., PH.D. McGill.

Douglas Keith Dale, B.A. Queen's, M.S. North Carolina, F.S.S.

Donald Andrew Dawson, B.SC., M.SC. McGill, PH.D. M.I.T.

J. D. Dixon, M.A. Melbourne, PH.D. McGill.

Vlastimil Dlab, RNDR, C.SC. Charles, Prague, PH.D. Khartoum, D.SC. Charles.

Fiala Frantisek, RNDR, C.SC. Brno.

Roger M. Fischler, B.SC. Polytechnic Inst. of Brooklyn, M.A., PH.D. Oregon.

Cyril W. L. Garner, B.SC. New Brunswick, M.A., PH.D. Toronto.

J. E. Graham, B.SC. Carleton, M.A. Queen's, PH.D. Iowa State.

Kenneth Hardy, B.SC. Leicester, M.S., PH.D. McGill.

Marianne Helfenstein, B.SC. Alberta.

Edward Hughes, B.A. Rice, PH.D. Wisconsin.

A. B. M. L. Kabir, M.SC. Dacca, PH.D. Western Ontario.

Moray St. John Macphail, B.A. Queen's, M.A. McGill, D.PHIL. Oxford, F.R.S.C.

Paul Mandl, M.A., PH.D. Toronto.

L. E. May, B.SC., M. PHIL. London, PH.D. North Carolina.

M. J. Moore, M.SC., PH.D. Birmingham.

L. D. Nel, M.SC. Stellenbosch, PH.D. Cambridge.

Edward J. Norminton, M.A. Western Ontario, PH.D. Toronto.

F. H. Northover, M.A. Cambridge, PH.D. London.

J. N. Pandey, M.SC. Hindu, PH.D. New York.

John C. Poland, M.SC., PH.D. McGill.

Irwin S. Pressman, B.SC. Manitoba, PH.D. Cornell.

B. M. Puttaswamaiah, M.SC. Mysore, M.A., PH.D. Toronto.

Mizanur Rahman, M.SC. Dacca, M.A. Cambridge, PH.D. New Brunswick.

Luis Ribes, M.A., PH.D. Rochester, D.SC. Madrid.

R. L. Rosenberg, M.A. Cape Town, D.I.C. Imperial College, PH.D. Berlin.

A. K. Md. Ehsanes Saleh, M.SC. Dacca, M.A., PH.D. Western Ontario.

Helga H. Schirmer, M.A., PH.D. Frankfurt.

Walter Schneider, B.SC. Columbia, M.S. Rensselaer Polytech., PH.D. Tulane.

R. J. Semple, M.A. Toronto, PH.D. Princeton.

Derek William Sida, M.SC., PH.D. London.

Arthur Smith, B.A. Oxford, PH.D. Manchester.

Peter Tan, B.SC. Sun Yat Sen, B.A. Luther, M.A. Saskatchewan, PH.D. Toronto.

Marion J. Watson, M.SC. Queen's.

Kenneth Stuart Williams, B.SC. Birmingham, M.A., PH.D. Toronto.

Graham Zelmer, B.SC. Manitoba, PH.D. British Columbia.

Department of Philosophy

J. A. Brook, M.A. Alberta.

S. G. Clarke, B.A. Saskatchewan, PH.D. Duke.

D. E. Dubrule, B.A. Cornell, M.A., PH.D. Toronto.

B. I. Egyed, B.A. Sir George Williams, M.A., PH.D. McGill.

A. Jeffrey, M.A. St. Andrews.

J. W. Leyden, B.A. Keele.

R. R. A. Marlin, A.B. Princeton, M.A. McGill.

J. T. O'Manique, B.SC. St. Patrick's, B.PH., PH.L., PH.D. Ottawa, D.PH. St. Paul.

R. S. Talmage, M.A. Oxford.

J. M. Thompson, M.A. Toronto.

B. Wand, B.A. Queen's, M.A., PH.D. Cornell.

J. C. S. Wernham, M.A. Aberdeen and Cambridge, S.T.M. Union.

J. Wolfe, B.A. Carleton.

Department of Physics

R. D. Barton, M.SC., PH.D. McGill.

D. J. Brown, B.SC. Birmingham, PH.D. Cornell.

A. L. Carter, M.SC. Dalhousie, PH.D. McGill.

R. L. Clarke, B.SC. Alberta, PH.D. McGill.

T. J. S. Cole, B.SC. London and Carleton, PH.D. Cantab., A.C.G.I.

L. A. Copley, B.SC. Carleton, M.SC. McMaster, PH.D. Toronto.

K. W. Edwards, B.S.E. Michigan, PH.D. Princeton.

J. E. Hardy, B.A., M.SC. British Columbia, PH.D. Princeton.

*C. K. Hargrove, B.A. New Brunswick, B.SC., M.A., PH.D. McGill.

*G. Herzberg, DR. ING. Darmstadt, F.R.S., F.R.S.C.

E. P. Hincks, B.A., M.A. Toronto, F.R.S.C.

D. Kessler, M.SC. Jerusalem, D. ES SC. Sorbonne.

R. Morrison, B.ENG. McGill, DOCT (3 ième Cycle) Paris.

L. Resnick, B.SC., M.SC. McGill, PH.D. Cornell.

W. J. Romo, B.SC., M.SC., Oregon, PH.D. Wisconsin.

M. K. Sundaresan, B.SC., M.SC. Delhi, PH.D. Cornell.

J. Walters, B.SC., PH.D. Imperial College, London.

Department of Political Science

Claude Ake, B.SC. London, M.A., PH.D. Columbia.
Jon Alexander, M.A. South Illinois, PH.D. Kansas.
Douglas G. Anglin, B.A. Toronto, M.A., D.PHIL. Oxford.
B. R. Bociurkiw, M.A. Manitoba, PH.D. Chicago.
Adam Bromke, M.A. St. Andrews, PH.D. Montreal and McGill.
Nguyen H. Chi, BACCALAUREAT, LICENCE EN DROIT, Saigon, PH.D. Michigan State.
G. B. Doern, B.COM. Manitoba, M.A. Carleton, PH.D. Queen's.
Teresa R. Harmstone, B.A. McGill, A.M. Radcliffe, PH.D. Harvard.
Robert J. Jackson, M.A. Western Ontario, D.PHIL. Oxford.
Pauline Jewett, M.A. Queen's, PH.D. Harvard.
Frederick Kirk, Jr., B.A. Exeter, PH.D. North Carolina.
David Kwavnick, B.A. McGill, M.A., PH.D. Carleton.
Peyton V. Lyon, B.A. Manitoba, M.A., D.PHIL. Oxford.
Robert Alexander MacKay, B.A. Toronto, PH.D. Princeton, LL.D. Dalhousie, F.R.S.C.
Kenneth Douglas McRae, B.A. Toronto, A.M., PH.D. Harvard.
H. B. Mayo, B.A. Dalhousie, M.A., D.PHIL. Oxon, F.R.S.C.
W. A. Mullins, B.S. Portland, M.A. Arizona, PH.D. Washington.
John R. Nellis, M.A., PH.D. Syracuse.
Michael Oliver, M.A., PH.D., LL.D. McGill.
Khayyam Z. Paltiel, B.A. McGill, M.A. Toronto, PH.D. Jerusalem.
Jon H. Pammett, M.A. Queen's, PH.D. Michigan.
Harald von Riekhoff, B.A. Western Ontario, M.A., PH.D. Yale.
George Roseme, A.B. California, M.A. Sacramento State.
Paul L. Rosen, B.A. Lehigh, M.A., PH.D. New School for Social Research.
Donald C. Rowat, B.A. Toronto, A.M., PH.D. Columbia.
Radoslav Selucky, GRAD. DIP., C.SC. Prague.
John H. Sigler, A.B. Dartmouth, M.A. Georgetown, PH.D. Southern California.
I. G. Stevenson, M.A. McGill, PH D. Princeton.
E. L. Tepper, B.A. Michigan, M.A. American University, PH.D. Duke.
B. W. Tomlin, B.A. McMaster, PH.D. York.
Richard J. Van Loon, M.A. Carleton, PH.D. Queen's.
J. M. Vickers, B.A. Carleton, PH.D. L.S.E.
M. S. Whittington, M.A. Carleton.
V. Seymour Wilson, B.SC. British Columbia, D.P.A., M.A. Carleton, PH.D. Queen's.

Department of Psychology

Donald A. Andrews, B.A., M.A. Carleton, PH.D. Queen's.
John C. Barefoot, A.B. North Carolina, M.A. Bryn Mawr, PH.D. North Carolina.
L. Ray Barnett, M.A., PH.D. Oregon.
David Karl Bernhardt, B.A. Toronto, M.A. Michigan.
E. J. Burwell, B.A. Toronto, M.A. Carleton.

W. L. Croll, B.S., M.A., PH.D. Iowa.

Richard F. Dillon, A.B. Dartmouth, M.S. Florida, PH.D. Virginia.

Marjorie N. Donald, M.A., DIP. EDUC. New Zealand, PH.D. Michigan.

Bruce H. Ferguson, B.A., M.A. Queen's, PH.D. Monash.

Peter A. Fried, B.SC. McGill, M.A., PH.D. Waterloo.

Robert D. Hoge, B.A. Kenyon, M.A., PH.D. Delaware.

Jack D. Kelly, B.A. Southwestern, PH.D. Vanderbilt.

Robert M. Knights, B.A. Western Ontario, PH.D. Minnesota.

A. Bryan Laver, M.A. Queen's, PH.D. Ottawa.

Marilyn E. Marshall, B.A. Lake Erie, M.A. Bowling Green, PH.D. Iowa.

Peter D. McCormack, B.A. Carleton, M.A. Delaware, PH.D. Iowa.

Dan C. McIntyre, B.S. Carroll College Wisconsin, M.A. Northern Illinois.

Alan R. Moffitt, B.A., M.A. Western, PH.D. Minnesota.

Bruce A. Pappas, B.A., M.A., PH.D. Queen's.

John T. Partington, B.A., M.A., PH.D. Western Ontario.

William M. Petrusic, B.A. British Columbia, M.A., PH.D. Michigan.

Thomas J. Ryan, M.A. McMaster, PH.D. Iowa.

Herbert M. Simpson, M.A. British Columbia, PH.D. Western Ontario.

Donald S. Snedden, B.A., M.A. Queen's.

Lloyd H. Strickland, A.B. Johns Hopkins, PH.D. North Carolina.

Jo Tombaugh, B.A. DePauw, M.A., PH.D. Missouri.

Tom N. Tombaugh, B.A. DePauw, M.A., PH.D. Missouri.

Frank R. Wake, B.A., PH.D. McGill.

W. E. Walther, B.A. Chico State, M.SC. San Diego, PH.D. Iowa.

William G. Webster, B.SC. McGill, M.A. Cornell.

Roger B. Wells, B.A. Reed, M.A., PH.D. North Carolina.

Russell Allan Wendt, M.A. Alberta.

Donald W. Zimmerman, A.B. Indiana, M.A., PH.D. Illinois.

School of Social Work

S. James Albert, B.SC. Carleton, M.S.W. Toronto, D.S.W. Columbia.

Jeanne Fortin, B.A., M.S.W. Montreal, ADV. DIP. McGill.

Kurt A. Fuerst, M.A., M.S.W. Manitoba.

Leah Goldenberg, B.A., M.S.W., ADV. DIP. Toronto.

James M. Gripton, B.A., D.S.W. Toronto.

Mary M. MacLean, B.A., M.S.W. McGill.

James B. Mair, B.A. Sir George Williams, M.S.W. Wayne State.

Edith E. Moore, B.A. Toronto, M.S.W. Ottawa.

Violet B. Munns, B.A., DIP.S.W. Toronto, A.M. Chicago.

Alice A. Selyan, B.A., DIP.S.W. Toronto.

Arthur Stinson, B.A. Toronto.

Mary E. Valentich, B.A. McMaster, M.S.W. Ottawa.

Nicole M. Vanier, B.SC., M.S.S. Montreal.

Department of Sociology and Anthropology

Charles Ackerman, B.A. U.C.L.A., PH.D. Harvard.

Monica Boyd, B.A. Chicago, M.A. Duke.

John Cove, B.A., M.A. Dalhousie, PH.D. British Columbia.

Bruce Cox, B.A. Reed, M.A. Oregon, PH.D. California.

Rodney K. Crook, B.A. Leeds, A.M., PH.D. Princeton.

John deVries, B.A. Sir George Williams, M.S. Wisconsin.

Bonnie Erickson, B.A., M.A. British Columbia.

Colin Farmer, B.A., M.A. British Columbia.

Dennis P. Forcese, B.S., M.A. Manitoba, PH.D. Washington at St. Louis.

Muni Frumhartz, B.A. Toronto, A.M. Columbia.

Charles Gordon, B.A. Amherst.

John Harp, B.A. Saskatchewan, M.SC., PH.D. Iowa State.

Kenneth Hatt, B.A. Redland, M.A. California State, PH.D. Alberta.

Phillip Hughes, B.A. London, M.A. New Mexico State.

Gordon Irving, O.M.I., B.A. St. Patrick's, PH.D. Notre Dame.

Barclay Johnson, B.A. Harvard, M.A. California.

C. Stanley Jones, B.S. Missouri Valley, M.A. Washington at St. Louis.

Zbigniew Jordan, M.A., PH.D. Poznan.

Donald MacLeod, B.A. Seattle, M.A. Washington State.

Joseph Manyoni, B.A. South Africa, B.LITT. Oxford.

Bruce A. McFarlane, B.A., M.A. McGill, PH.D. London.

Kenneth A. Mozersky, B.A. Manitoba, M.A., PH.D. Cornell.

Gertrud Neuwirth, DR. RER. POL. Graz, PH.D. Minnesota.

Terrance Nosanchuk, B.A. Wayne State, M.A., PH.D. Chicago.

Ian Pool, B.A., M.A. New Zealand, PH.D. Australian National.

John Porter, B.SC., D.SC. London.

Ian Prattis, B.A. London, B.LITT. Oxford, PH.D. British Columbia.

Stephen Richer, B.A., M.A. McGill, PH.D. Johns Hopkins.

Derek Smith, B.A. British Columbia, M.A., PH.D. Harvard.

Allan D. Steeves, B.S.A., M.S.A. Toronto, PH.D. Michigan State.

*Leroy Stone, A.B. Howard, PH.D. Pennsylvania.

Victor F. Valentine, B.A., M.A. Toronto.

Frank G. Vallee, B.A. McGill, PH.D. London.

James Vantour, B.A. Alberta, M.A. Utah.

Caryl Wells, B.A., M.A. Maryland, PH.D. North Carolina.

Donald R. Whyte, B.SC. Manitoba, M.SC., PH.D. Cornell.

Department of Spanish

F. Atienza, B.T. Salamanca, LIC.T. Innsbruck, LIC. J. C. Rome, D.J.C., D.S.T. Ottawa.

F. Hernández, LIC. Fᵃ Y. LETRAS, Barcelona, M.A. Toronto.

R. L. Jackson, B.A. Knoxville, M.A., PH.D. Ohio State.

J. Jurado, DR. Fᵃ. Y LETRAS Madrid.

R. Larson, M.A. Toronto.

A. López-Fernández, BACH. Fᵃ. Y LETRAS Santiago de Compostela, LIC. Fᵃ. Y LETRAS, DR. Fᵃ. Y LETRAS Madrid.

José M. López-Saiz, M.A. British Columbia.

C. A. Marsden, M.A., PH.D. Cambridge.

P. J. Roster, Jr., M.A. Rutgers.

A. W. Urrello, M.A. Northern Illinois, M.A. Southern Illinois, PH.D. Southern Illinois.

CALENDAR OF MILESTONES

The Institution

1941	The Ottawa Association for the Advancement of Learning was established to develop Carleton College. At first the College offered only evening classes in introductory university subjects, with some courses in Public Administration.
1943	The incorporation of the Ottawa Association for the Advancement of Learning.
1945	Beginning of day classes and full-time teaching in Arts, Science, Journalism and first year Engineering. Establishment of the Faculty of Arts and Science.
1946	Move from rented premises to the First Avenue campus, formerly Ottawa Ladies' College. First degrees were awarded in Journalism and Public Administration.
1947	The College committed itself to develop pass and honours programs, the second year of the program being offered for the first time in 1947-48, the third year in 1948-49, and the fourth (honours) year in 1949-50.
1949	First degrees in Arts, Science, and Commerce awarded. Formation of Senate.
1950	First honours degree in Arts and Science awarded.
1952	The Carleton College Act, 1952 passed by the Ontario Legislature. This changed the corporate name to Carleton College. It also confirmed the power to grant degrees.
1952-53	Property for Rideau River campus acquired.
1953	Establishment of the School of Public Administration.
1954	Appointment of Architectural Associates for Carleton to prepare a master plan for Rideau River campus and to design the first group of buildings. First honorary degree of LL.D. conferred on Dag Hammarskjold, Secretary-General of the United Nations.
1955	First Master of Arts degree awarded.
1957	The Carleton University Act, 1957. Establishment of the School of Engineering. Establishment of the Institute of Canadian Studies.
1958	First Master of Science degree awarded.

1959	Move to Rideau River campus, following construction of the Henry Marshall Tory Building (science), the Maxwell MacOdrum Library, and the Norman Paterson Hall (arts).
1961	First Ph.D. degree in Science awarded.
	First degrees in Engineering awarded.
1962	Southam Hall, the University Commons, Renfrew House (residence) and Lanark House (residence) completed. Paterson Hall extended and University Union opened.
1963	First Master of Engineering degree awarded.
	Reorganization into Faculties of Arts, Engineering, Science, and Graduate Studies.
	Extension to MacOdrum Library completed.
1964	The C. J. Mackenzie Building (engineering) completed.
1965	The E. W. R. Steacie Building (chemistry) completed.
	Grenville House and Russell House (residences) completed.
	Maintenance Building and Heating Plant completed.
1966	First Ph.D. degree in Engineering awarded.
	The Physics Building completed. Designated in 1972 as the Herzberg Laboratories.
	First extension to the C. J. Mackenzie Building completed.
	Extension to Southam Hall completed.
	Establishment of the School of International Affairs.
	Establishment of the School of Commerce.
1967	Loeb Building (social sciences) completed.
	Integration of St. Patrick's College as a division of the Faculty of Arts.
	Integration of the School of Social Work.
1968	First Ph.D. degree in Arts awarded.
	First Master of Social Work degree awarded.
	Establishment of the School of Architecture.
	Second extension to the C. J. Mackenzie Building completed.
1969	Controlled Environmental Facility (biology) completed.
	Addition to the Heating Plant completed.
	Addition to University Union (gymnasium) completed.
	Administration Building, Glengarry House (residence) and University Commons (residence cafeteria) completed.
1970	University Centre and Parking Garage completed.
1971	Arts Tower completed.
1972	Architecture Building completed.
	School of Social Work accommodated on the Rideau River campus.

1973   St. Patrick's College moves to new facility on the Rideau River campus.

First degrees in Architecture awarded.

Presidents

1942-1947	Henry Marshall Tory
1947-1955	Murdoch Maxwell MacOdrum
1955-1956	James Alexander Gibson (acting)
1956-1958	Claude Thomas Bissell
1958-1972	Davidson Dunton
1972-	Michael K. Oliver

Chancellors

1952-1954	Harry Stevenson Southam
1954-1968	Chalmers Jack Mackenzie
1969-1972	Lester Bowles Pearson
1973-	To be announced

Graduate Diplomas and Degrees Awarded

	D.P.A.	M.A.	M.Sc.	M.Eng.	M.S.W.	Ph.D.
1954	3					
1955	3	1				
1956	4	3				
1957	1	2				
1958	3	3	1			
1959	10	3	-			
1960	8	2	-			
1961	11	11	2			1
1962	4	13	7			-
1963	15	6	7	1		-
1964	9	19	5	2		1
1965	26	32	8	16		2
1966	18	59	13	15		5
1967	26	55	14	21		2
1968	28	88	21	22	34	12
1969	26	117	23	18	38	14
1970	34	142	32	29	44	10
1971	46	137	36	27	41	17
1972	34	193	29	41	47	19
TOTALS	309	886	198	192	204	83

The University also publishes the Undergraduate Calendar available from:

The Registrar
Carleton University
Ottawa, Canada K1S 5B6